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# Compendium Of NASA Data Base For The Global Tropospheric Experiment's Arctic Boundary Layer Experiments ABLE-3A And ABLE-3B

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(NASA-TM-109161) COMPENDIUM OF  
NASA DATA BASE FOR THE GLOBAL  
TROPOSPHERIC EXPERIMENT'S ARCTIC  
BOUNDARY LAYER EXPERIMENTS ABLE-3A  
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COMPENDIUM OF NASA DATA BASE FOR THE  
GLOBAL TROPOSPHERIC EXPERIMENT'S  
ARCTIC BOUNDARY LAYER EXPERIMENTS ABLE-3A AND ABLE-3B

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SUMMARY

The report provides a compendium of NASA aircraft data that are available from NASA's Global Tropospheric Experiment's (GTE) Arctic Boundary Layer Experiments (ABLE) conducted in July and August of 1988 (ABLE-3A) and 1990 (ABLE-3B). ABLE-3A flight experiments were primarily based at Barrow and Bethel, Alaska, and included survey/transit flights to Thule, Greenland; northward of Thule; and eastward of Goose Bay, Labrador. ABLE-3B flight experiments were based at North Bay (Ontario) and Goose Bay, Canada, and included flights northward to Frobisher Bay, Canada. The primary purposes of the experiments were (1) the measurement of the flux of various trace gases (e.g., methane, carbon monoxide, ozone, and water vapor) from high-arctic (tundra and boreal) and Canadian (Hudson Bay lowlands, forest/wetlands) ecosystems, (2) the elucidation of factors important to the production and destruction of ozone at high northern latitudes, and (3) the documentation of the types (source and chemical signature) of air common to and transported into the regions. The format of the report utilizes data plots--time series and altitude profiles--of selective data acquired aboard the NASA/Wallops Electra aircraft. The purpose of the report is to provide a representation of aircraft data that are available in archived format via NASA Langley's Distributed Active Archive Center (DAAC). The data format is not intended to support original research/analyses, but to assist the reader in identifying data that are of interest. This compendium is for only the NASA aircraft data. The archived data bases include numerous supporting data including meteorological observations/products, results from surface studies, satellite observations, and sondes releases.

## INTRODUCTION

The goal of the NASA Tropospheric Chemistry Program is to develop an understanding of the chemical cycles that control the composition of the troposphere and to assess the susceptibility of the global atmosphere to chemical change. A major component of the NASA program is the Global Tropospheric Experiment (GTE), which consists of a series of field experiments designed to (1) evaluate the capability of instrument techniques to measure, under field condition, the minute concentrations of key chemical species in the atmosphere, and (2) systematically address tropospheric chemistry issues relevant to global change, through airborne sampling expeditions, coupled with modeling and laboratory studies. GTE is primarily an aircraft-based program supplemented by ground-based measurements. Satellite data also play important roles. Space Shuttle observations of tropospheric carbon monoxide distributions have been used to plan and direct the course of expeditions, for example, over tropical rain forests and for continental outflow into the tropical Atlantic Ocean. Landsat land-surface images have facilitated the extrapolation of regional Arctic-tundra measurements into global-scale conclusions. Total Ozone Measurements from Satellites (TOMS) have helped place GTE observed ozone distributions/budgets into a global perspective (temporal and spatial). Weather data returned by environmental satellites have guided flight planning for research flights. The Distributed Active Archive Center (DAAC) data include many of the satellite, surface, and meteorological products used to support GTE missions or analyses.

The GTE airborne expeditions have focused on studies of the remote global atmosphere in order to provide well-documented baseline measurements of the unperturbed environment and to fully understand the chemical cycles underlying the natural environment. Table 1 and Figure 1 summarize GTE missions conducted through March 1994. The GTE expeditions have been conducted in a diverse range of environments and with different scientific goals. The Chemical Instrument Test and Evaluation (CITE) series was designed to study our ability to measure key tropospheric gaseous species by exposing selected instrumentation to a wide range of measurement conditions. The Atmospheric Boundary Layer Experiments were designed to study the emission, chemical processes, and dynamics of the boundary layer, and have been conducted over ecosystems known to have significant influence on the global troposphere. The importance of long-range transport of natural and anthropogenic emissions on the global troposphere has been investigated in the Pacific Exploratory Missions (PEM) and the Transport and Atmospheric Chemistry Experiment in the Atlantic (TRACE-A).

The GTE, managed through the Tropospheric Chemistry Program in the Mission to Planet Earth Office, NASA Headquarters, was initiated in the early 1980s. Implementation of the GTE Project is via a Project Office at the NASA Langley Research Center, Atmospheric Sciences Division.

## SYMBOLS AND UNITS

ABLE	Arctic Boundary Layer Experiment
CITE	Chemical Instrument Test and Evaluation
CO	carbon monoxide
C2Cl4	tetrachloroethylene
DAAC	Distributed Active Archive Center
deg.	degree
dp	dew point temperature, degree Centigrade
Ga.Inst. of Tech.	Georgia Institute of Technology, Atlanta, Georgia
GTE	Global Tropospheric Experiment
LaRC	Langley Research Center
M	mission
NASA	National Aeronautics and Space Administration
NO	nitric oxide
NO <sub>x</sub>	nitric oxides (nitric oxide + nitrogen dioxide)
NO <sub>y</sub>	total odd nitrogen
no./cm <sup>3</sup>	number of aerosols (0.12 to 3.12 $\mu$ m diameter) per cm <sup>3</sup> of air
O <sub>3</sub>	ozone
PAN	peroxyacetyl nitrate
PEM	Pacific Exploratory Mission
pptv	parts-per-trillion, by volume
ppbv	parts-per-billion, by volume
Rel. Humidity	relative humidity, percent
T	air temperature, degree Centigrade
TAMMS	Turbulent Air Motion Monitoring System
Theta	potential temperature, degree Kelvin
TOMS	Total Ozone Measurements from Satellites
TRACE-A	Transport and Atmospheric Chemistry Experiment in the Atlantic
Univ.of Calif.	University of California at Irvine, California at Irvine
Univ.of New Hamp.	University of New Hampshire, Durham, New Hampshire

## PROGRAM AND DATA DESCRIPTIONS

### Arctic Boundary Layer Experiment: ABLE-3A

The Arctic Boundary Layer Experiment (ABLE-3A) was conducted in Arctic and sub-Arctic regions of North America and Greenland during July and August 1988. This was the first comprehensive investigation of sources, sinks, and distribution of trace gas and aerosol chemical species in a northern high-latitude region during summer months. The experimental design placed emphasis on the role of biosphere-atmosphere interactions in determining the chemical composition of the troposphere, on processes which influence the tropospheric ozone budget, and the importance of long-range transport as a source of pollutants in the remote Arctic regions. The centerpiece of ABLE-3A was a series of 33 research flights with the instrumented NASA Wallops Electra aircraft. A core set of measurements aboard the aircraft focused on eddy correlation flux measurements (methane, carbon monoxide, and ozone) with instrumentation of 10-Hz response. NASA's boom-mounted turbulent air motion system provided correlation data for the fast-response chemical sensors. A sizable amount of mission flight time was dedicated to low-altitude (150 to 1000 m) flight in support of flux studies. Figure 2 shows the study region as well as flight lines for survey/transit flights northward to Alert and eastward to Frobisher and Goose Bay, Canada. An intensive surface site (tower and chamber flux studies) was established at Bethel, Alaska, and provided information on the interpretation of fluxes from the micro (chamber) to the regional (aircraft) scale.

The ABLE-3A data archive includes (1) data taken aboard the NASA Wallops Electra aircraft; (2) data measured at the Bethel surface site; (3) sondes released from multiple locations in support of the aircraft flights; and (4) numerous meteorological, land-use, and satellite data products used in flight (field) planning and post-mission analyses. The aircraft data included the following suite of chemical measurements: methane, carbon monoxide, carbon dioxide, nonmethane hydrocarbons, acetic acid, formic acid, nitric oxide, nitrogen dioxide, total odd or "reactive" nitrogen gaseous species, peroxyacetyl nitrate, peroxypropionyl nitrate, ozone, radon gas, and aerosol chemical composition and size distribution. Table 2 identifies investigators responsible for the measurements, and Figure 3 shows a schematic of the aircraft instrument plan.

The aircraft platform as configured for ABLE-3A had a cruise speed at altitude of about 6 km/min and a maximum flight duration and ceiling of about 6 hours and 7 km, respectively. Table 3 summarizes each of the 33 flights. Survey flights were generally long-duration flights at high altitude (5 to 7

km) with (generally) at least one descent (spiral or ramp) to about 150 m above local terrain. Flux missions consisted of numerous short-duration (30 to 45 minute), low (below 1 km), and level flight legs, and included at least two altitude soundings to about 6 km. Other flights combined numerous profiles and level-flight legs to meet planned objectives. Generally, altitude profiles (spirals or ramps) were flown with ascent/descent rates of 150 to 200 m/min.

The data plots for the ABLE-3A missions are given in Appendix A. For each flight, three pages of time series plots are provided: page 1 - altitude, temperature, dew point temperature, relative humidity, potential temperature, aerosol; page 2 - ozone, carbon monoxide, nitric oxide, nitrogen oxides, total odd or "reactive" nitrogen gas species, peroxyacetyl nitrate; and page 3 - methane, acetylene, ethane, propane, tetrachloroethylene. The species were selected to provide the reader with information on both the source and photochemical history of the air. Figure numbers correspond to flight numbers; i.e., Figure A1.2 represent the page 2 plots for flight #1. Selected profile plots follow the time series plots as, for example, Figure A1.4. Profile plots include temperature, dew point temperature, ozone, carbon monoxide, and methane data plotted to the same altitude scale. One to three profile plots are provided for each flight. Table 4 summarizes the profiles selected. Data plots are in standardized format as discussed in the Introduction to the Appendices. The archive includes other aircraft specie data which have not been plotted in Appendix A.

#### Arctic Boundary Layer Experiment: ABLE-3B

The Arctic Boundary Layer Experiment (ABLE-3B) was conducted in north-central and northeastern regions of Canada during July and August 1990 and included a longitudinal survey of trace gas and aerosol species along the east coast of North America from 37° N to 65° N. ABLE-3B used ground, aircraft, and satellite measurements to study source, sink, and transport processes which influence the chemical climate of relatively remote sub-Arctic and Arctic regions of Canada. As was the case for ABLE-3A, the experimental design placed emphasis on the role of biosphere-atmosphere interactions in determining the chemical composition of the troposphere and on processes which influence the tropospheric ozone budget. An important piece of ABLE-3B was a series of 22 research flights with the instrumented NASA Wallops Electra aircraft. As was the case for ABLE-3A, a core set of measurements aboard the aircraft focused on eddy correlation flux measurements (methane, carbon monoxide, and ozone) with instrumentation of 10-Hz response, and NASA's boom-mounted turbulent air motion system provided correlation data for the fast-

response chemical sensors. A sizable amount (not as much as ABLE-3A) of mission flight time was dedicated to low-altitude (150 to 1000 m) flight in support of flux studies. Figure 4 shows the study regions as well as flight lines for survey/transit flights northward to Frobisher Bay. Intensive surface sites (flux measurements) were established at Kinosheo Lake in the Hudson Bay lowlands and in forest/wetlands near Schefferville (Quebec), Canada.

Similar to the ABLE-3A archive, the ABLE-3B data archive include (1) data taken aboard the NASA Wallops Electra aircraft; (2) data measured at the Kinosheo and Schefferville sites; (3) sondes released from multiple locations in support of the aircraft flights; and (4) numerous meteorological, land-use, and satellite data products used in flight (field) planning and post-mission analyses. The aircraft data included the following suite of chemical measurements: methane, carbon monoxide, carbon dioxide, nonmethane hydrocarbons, acetic acid, formic acid, nitric acid, nitric oxide, nitrogen dioxide, total odd or "reactive" nitrogen gaseous species, peroxyacetyl nitrate, peroxypropionyl nitrate, ozone, and aerosol chemical composition and size distribution. Table 2 identifies investigators responsible for the measurements and Figure 5 shows a schematic of the aircraft instrument plan. The aircraft as configured for ABLE-3B had similar flight characteristics as discussed for ABLE-3A. Table 5 summarizes the 22 research flights. Description of the various flights (survey, flux, etc.) are similar to those of ABLE-3A.

The data plots for the ABLE-3B missions are given in Appendix B. For each flight, three pages of time series plots are provided: page 1 - altitude, temperature, dew point temperature, relative humidity, potential temperature, aerosol; page 2 - ozone, carbon monoxide, methane, tetrachloroethylene, benzene, acetone; page 3 - nitric oxide, nitrogen oxides, total odd nitrogen gas, peroxyacetyl nitrate, nitric acid; and page 4 - acetylene, ethane, propane. The species were selected to provide the reader with information on both the source and photochemical history of the air. Figure numbers and plot formats are similar to those previously discussed for ABLE-3A. Table 6 summarizes the profiles selected. Again, data plots are in standardized format and not all data (species) measured on the aircraft have been plotted.



## CONCLUDING REMARKS

This compendium of data from NASA's Global Tropospheric Experiment's (GTE) Arctic Boundary Layer Experiments (ABLE-3A, 1988; ABLE-3B, 1990) provides only a representation of aircraft data that are available in archived format from NASA Langley's Distributed Active Archive Center (DAAC). The presented data are not intended to support original research/analyses, but serve to assist the reader in identifying data that are of interest and may be obtained from Langley's DAAC archive. This compendium is for only selected NASA aircraft data. The archived data bases include other data measured on board the aircraft as well as numerous supporting data including meteorological observations/products, results from surface studies, satellite observations, and sondes releases. GTE-sponsored analyses/results from the ABLE-3A and ABLE-3B expeditions have been published in Special Issues of the Journal of Geophysical Research - Atmospheres, Volume 97, Number D15, October 1992, and Volume 99, Number D1, January 1994, respectively.

Questions or information regarding the Langley DAAC archive should be directed to the Data Manager, DAAC, Atmospheric Sciences Division, Langley Research Center, Hampton, Virginia 23681-0001.



TABLE 1. GTE Field Expeditions

Expedition*	Date	General Geographic Region	Time of Year
CITE 1	1983	Hawaii	November
CITE 1	1984	Eastern North Pacific—off the California coast	April
CITE 2	1986	Western USA	August
CITE 3	1989	Western North Atlantic—off the Virginia coast and Western South Atlantic—off the Brazil coast	
ABLE 1	1984	Barbados, French Guyana	June
ABLE 2A	1985	Amazon Basin	August
ABLE 2B	1987	Amazon Basin	May
ABLE 3A	1988	Alaska—Barrow, Bethel, Cold Bay	July/August
ABLE 3B	1990	Hudson Bay, Schefferville	July/August
PEM-West A	1991	Western North Pacific Rim	October
PEM-West B	1994	Western North Pacific Rim	March
TRACE A	1992	Brazil, South Atlantic, southwest Africa	September

\*ABLE as used in the table is generic and means Atmospheric Boundary Layer Experiment, as opposed to Arctic Boundary Layer Experiment (text).

TABLE 2. Principal Investigators and Institutions Participating in Arctic Boundary Layer Expedition

Investigator	Institution	Investigation
Tropospheric Chemistry Program		
John Barrick	NASA Langley Research Center	airborne meteorological/position data
John Bradshaw	Georgia Institute of Technology	nitric oxide, nitrogen dioxide, NO <sub>y</sub>
Edward Browell	NASA Langley Research Center	aerosols, ozone profiles
Gerald Gregory	NASA Langley Research Center	ozone, aerosol size
Robert Harriss	University of New Hampshire	carbon dioxide <sup>1</sup>
Enio Pereira	Instituto de Pesquisas Espaciais, Brazil	radon <sup>1</sup>
John Ritter	NASA Langley Research Center	eddy correlation flux (CO, CH <sub>4</sub> , O <sub>3</sub> , H <sub>2</sub> O)
Sherwood Rowland	University of California-Irvine	nonmethane hydrocarbons
Glen Sachse	NASA Langley Research Center	carbon monoxide, methane
Hanwant Singh	NASA Ames Research Center	PAN, PPN, C <sub>2</sub> Cl <sub>4</sub> , aldehydes <sup>2</sup> , and ketones <sup>2</sup>
Robert Talbot	University of New Hampshire	aerosol composition, nitric and organic acids
Steven Wofsy	Harvard University	carbon dioxide <sup>2</sup>

<sup>1</sup> ABLE-3A

<sup>2</sup> ABLE-3B

TABLE 3. Summary of the Flights Conducted During the 1988 ABLE-3A Expedition

Mission Number	Flight Date	Departure		Arrival		Purpose
		Time	Location	Time	Location	
1	July 7	1312	NASA Wallops Island	1700	Thunder Bay	Latitudinal survey
2	July 7	1813	Thunder Bay	2108	Churchill	Latitudinal survey
3	July 8	1356	Churchill	1845	Thule	Latitudinal survey
4	July 9	1250	Thule	1844	Fairbanks	Longitudinal survey
5	July 10	1951	Fairbanks	2329	Barrow	Latitudinal survey
6	July 12-13	2332	Barrow	0304	Barrow	Correlations
7	July 13-14	1945	Barrow	0043	Barrow	Boundary layer composition
8	July 15-16	2033	Barrow	0046	Barrow	Boundary layer composition
9	July 17	1756	Barrow	2309	Barrow	Vertical distributions
10	July 18-19	1925	Barrow	0048	Barrow	Flux measurements
11	July 19-20	2024	Barrow	0153	Barrow	Vertical distributions
12	July 21-22	2303	Barrow	0349	Barrow	Vertical distributions
13	July 24	1801	Barrow	2343	Bethel	Latitudinal survey
14	July 26-27	2007	Bethel	0033	Bethel	Vertical distributions
15	July 27-28	2351	Bethel	0503	Bethel	Vertical distributions/correlations
16	July 28-29	1955	Bethel	0107	Bethel	Flux measurements
17	July 29-30	1859	Bethel	0016	Bethel	Land-sea interface
18	July 31	1707	Bethel	2214	Bethel	Flux measurements
19	Aug. 2-3	1855	Bethel	0010	Bethel	Land-sea interface
20	Aug. 3	1800	Bethel	2220	Bethel	Vertical distributions
21	Aug. 4	0001	Bethel	0404	Bethel	Vertical distributions
22	Aug. 7	1902	Bethel	2157	Cold Bay	Latitudinal survey
23	Aug. 7-8	2329	Cold Bay	0419	Cold Bay	Vertical distributions
24	Aug. 8	2206	Cold Bay	2331	Bethel	Latitudinal Survey
25	Aug. 9	0131	Bethel	0645	Bethel	Land-sea interface
26	Aug. 9-10	2057	Bethel	0156	Bethel	Flux measurements
27	Aug. 11-12	2136	Bethel	0015	Barrow	Latitudinal survey
28	Aug. 12	1723	Barrow	2224	Thule	Mid-troposphere distributions
29	Aug. 13	1330	Thule	1836	Thule	Latitudinal survey
30	Aug. 15	1200	Thule	1636	Frobisher Bay	Latitudinal survey
31	Aug. 15	1719	Frobisher Bay	2108	Goose Bay	Latitudinal survey
32	Aug. 16	1333	Goose Bay	1750	Portland	Latitudinal survey
33	Aug. 17	1340	Portland	1708	NASA LaRC	Latitudinal survey

Time is GMT.

TABLE 4. ABLE-3A Profiles

Flight	Date	Time	Latitude, ° N	Longitude, ° E
1	July 7	1645	48.1	- 88.8
2	July 7	1830	49.3	- 89.2
2	July 7	2100	58.6	- 94.2
3	July 8	1415	59.9	- 94.0
3	July 8	1830	76.1	- 70.1
4	July 9	1300	75.8	- 72.2
4	July 9	1830	64.9	- 147.5
5	July 10	2300	70.6	- 157.1
6	July 13	0215	70.4	- 153.7
7	July 13	2200	74.0	- 166.0
8	July 15	2230	72.9	- 157.9
9	July 17	1800	71.1	- 155.8
10	July 18	2010	70.5	- 160.0
10	July 18	2315	70.1	- 154.8
11	July 19	2130	71.5	- 160.0
11	July 19	2245	70.4	- 160.0
12	July 22	0000	72.2	- 157.1
12	July 22	0215	70.6	- 159.0
13	July 24	2045	64.0	- 163.4
13	July 24	2245	61.1	- 161.9
14	July 26	2130	61.1	- 162.0
15	July 28	0200	62.6	- 158.4
16	July 28	2045	61.4	- 160.7
16	July 29	0015	60.8	- 162.9
17	July 29	1945	61.8	- 163.0
17	July 29	2215	57.5	- 163.0
18	July 31	1800	61.4	- 161.4
18	July 31	1930	60.4	- 164.2
19	August 2	1945	61.1	- 162.0
19	August 2	2200	58.4	- 168.0
20	August 3	1930	62.2	- 160.3
20	August 3	2115	61.3	- 161.5

Time is GMT

TABLE 4. ABLE-3A Profiles Continued

Flight	Date	Time	Latitude, ° N	Longitude, ° E
21	August 4	0130	62.2	- 160.4
21	August 4	0300	61.3	- 161.5
22	August 7	2000	57.9	- 159.9
23	August 8	0045	54.3	- 160.0
23	August 8	0230	53.6	- 162.5
24	August 8	2215	55.7	- 162.7
24	August 8	2330	60.5	- 161.9
25	August 9	0230	61.7	- 163.0
25	August 9	0430	57.5	- 163.0
27	August 11	2145	61.6	- 161.4
27	August 12	0000	71.2	- 157.0
28	August 12	1730	71.9	- 155.2
28	August 12	2215	76.6	- 70.0
29	August 13	1530	83.0	- 57.4
29	August 13	1700	80.9	- 63.7
30	August 15	1230	75.4	- 68.9
30	August 15	1400	72.0	- 68.8
30	August 15	1615	64.7	- 68.4
31	August 15	1845	61.1	- 66.0
31	August 15	2045	54.5	- 60.3
32	August 16	1515	49.7	- 61.1
33	August 17	1615	38.0	- 75.5

TABLE 5. Summary of the Flights Conducted During the 1990 ABLE-3B Expedition

Mission Number	Flight Date	Departure		Arrival		Purpose
		Time	Location	Time	Location	
1	July 6	1446	NASA Wallops Island	1715	North Bay	Latitudinal survey
2	July 9	1736	North Bay	2322	North Bay	Flux survey, Hudson Bay lowland, Kinoshao Lake
3	July 11	1706	North Bay	2224	North Bay	Flux survey, Hudson Bay lowland
4	July 17	1230	North Bay	1759	North Bay	Flux survey, Hudson Bay lowland, Kinoshao Lake (haze)
5	July 21	1224	North Bay	1814	North Bay	Flux survey, Hudson Bay lowland (north)
6	July 21	1932	North Bay	2415	North Bay	Haze chemistry
7	July 22	1559	North Bay	2049	North Bay	Nitrogen budget
8	July 26	1249	North Bay	1826	North Bay	Flux study, Hudson Bay lowland, Kinoshao Lake
9	July 26	1940	North Bay	2442	North Bay	Nitrogen budget, tundra fire
10	July 30	1549	North Bay	2041	Goose Bay	Transit
11	August 1	1355	Goose Bay	1916	Goose Bay	Flux survey, Schefferville, Quebec
12	August 3	1156	Goose Bay	1916	Goose Bay	Flux study, Schefferville, Quebec (haze)
13	August 5	1310	Goose Bay	1859	Goose Bay	Flux, survey, nitrogen budget, Labrador
14	August 7	1600	Goose Bay	2016	Goose Bay	Nitrogen budget / flux survey, Schefferville, Quebec
15	August 8	1235	Goose Bay	1754	Goose Bay	Flux survey, Schefferville, Quebec
16	August 9	1557	Goose Bay	2033	Goose Bay	Marine troposphere
17	August 11	1940	Goose Bay	2503	Goose Bay	Flux survey, Schefferville, Quebec
18	August 13	1215	Goose Bay	1707	Frobisher Bay	Latitudinal survey
19	August 13	1806	Frobisher Bay	2253	Goose Bay	Latitudinal survey
20	August 14	1612	Goose Bay	1913	Bagotville	Latitudinal survey
21	August 14	2018	Bagotville	2236	Portland	Latitudinal survey
22	August 15	1432	Portland	1903	NASA LaRC	Latitudinal survey

Time is GMT



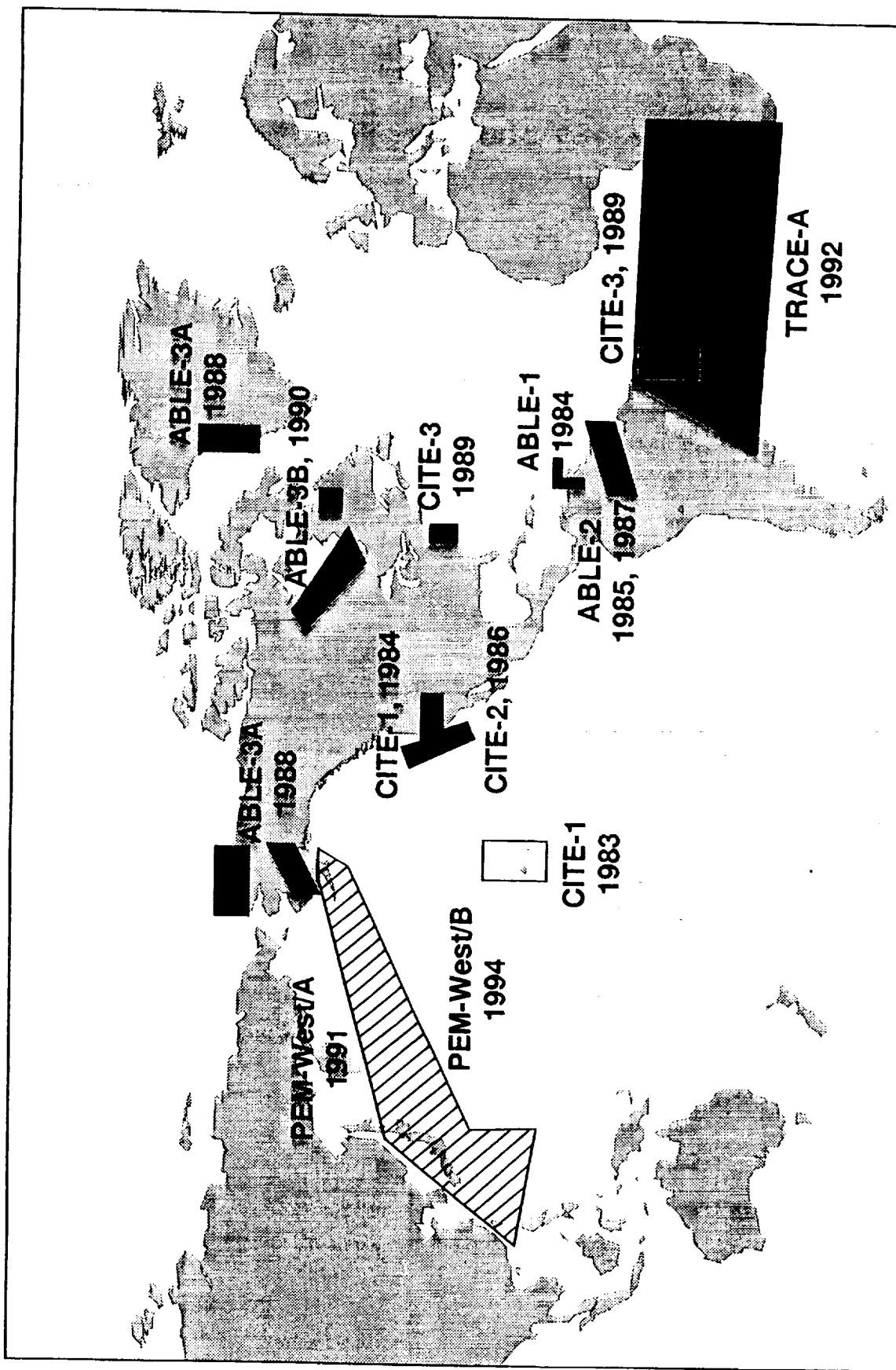
TABLE 6. ABLE-3B Profiles

Flight	Date	Time	Latitude, ° N	Longitude, ° E
1	July 6	1500	38.7	- 75.5
1	July 6	1700	45.5	- 79.4
2	July 9	2030	51.6	- 84.0
2	July 9	2200	50.1	- 81.4
3	July 11	1900	51.0	- 85.9
3	July 11	2130	50.3	- 81.0
4	July 17	1415	51.6	- 81.0
4	July 17	1645	51.1	- 81.7
5	July 21	1545	55.7	- 89.4
6	July 21	2130	56.7	- 105.8
6	July 22	0010	58.6	- 94.3
7	July 22	1900	51.5	- 81.8
7	July 22	2045	46.4	- 79.8
8	July 26	1500	51.0	- 80.9
8	July 26	1820	46.7	- 79.4
9	July 26	2130	51.6	- 81.7
9	July 27	0030	46.3	- 79.4
10	July 30	1900	54.9	- 66.6
10	July 31	2030	53.2	- 60.3
11	August 1	1530	54.9	- 66.6
11	August 1	1730	55.0	- 66.9
12	August 3	1315	54.9	- 66.7
12	August 3	1600	53.3	- 61.0
13	August 5	1430	52.3	- 57.1
13	August 5	1745	52.2	- 59.0
14	August 7	1730	54.9	- 66.6
14	August 7	1945	54.8	- 66.6
15	August 8	1400	54.8	- 66.6
15	August 8	1615	54.9	- 66.6

Time is GMT

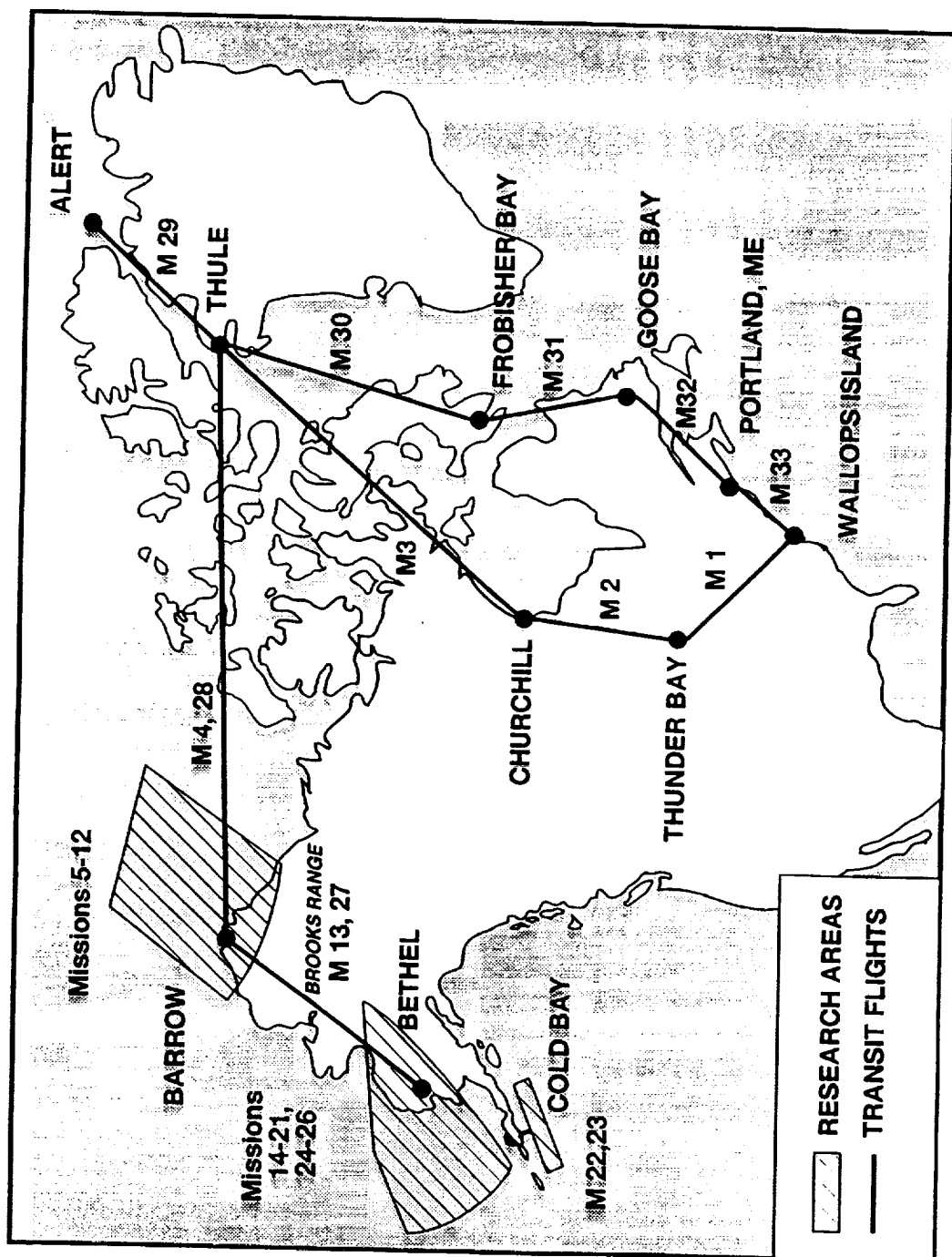
TABLE 6. ABLE-3B Profiles Continued

Flight	Date	Time	Latitude, ° N	Longitude, ° E
16	August 9	1800	53.5	- 49.9
16	August 9	2015	53.4	- 59.9
17	August 11	2130	54.9	- 66.6
17	August 12	0015	54.3	- 64.5
18	August 13	1400	57.3	- 65.9
18	August 13	1545	61.0	- 67.0
19	August 13	1900	61.3	- 69.6
19	August 13	1945	59.2	- 66.9
20	August 14	1830	50.0	- 70.0
21	August 14	2145	45.4	- 71.5
22	August 15	1600	41.6	- 74.5
22	August 15	1815	38.2	- 74.8



JH-GTE-002-0563/BA W

Figure 1: GTE Mission Sites



RH/A3A/Fig.04

Figure 2: Map of the Regions Studied by ABLE-3A

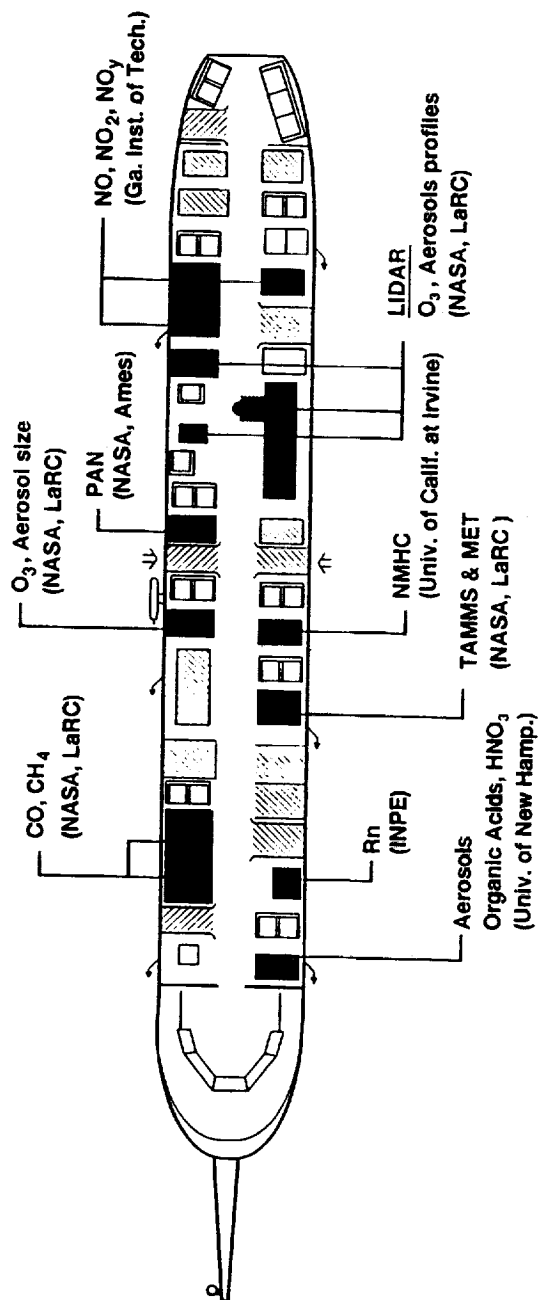
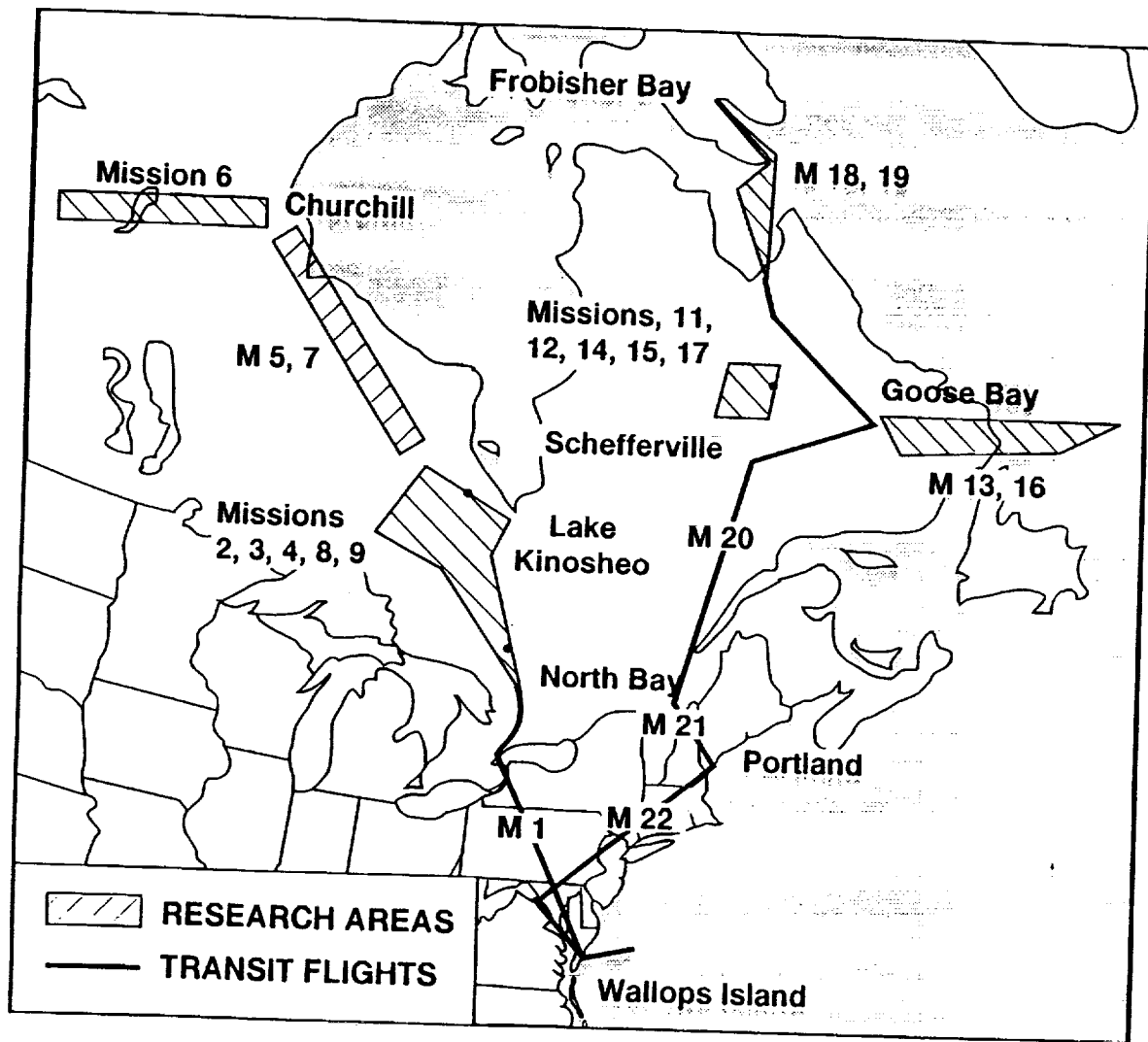


Figure 3: NASA Research Aircraft and the Location of Instrumentation During ABLE-3A



RHA3A/Fig 05

Figure 4: Map of the Regions Studied by ABLE-3B

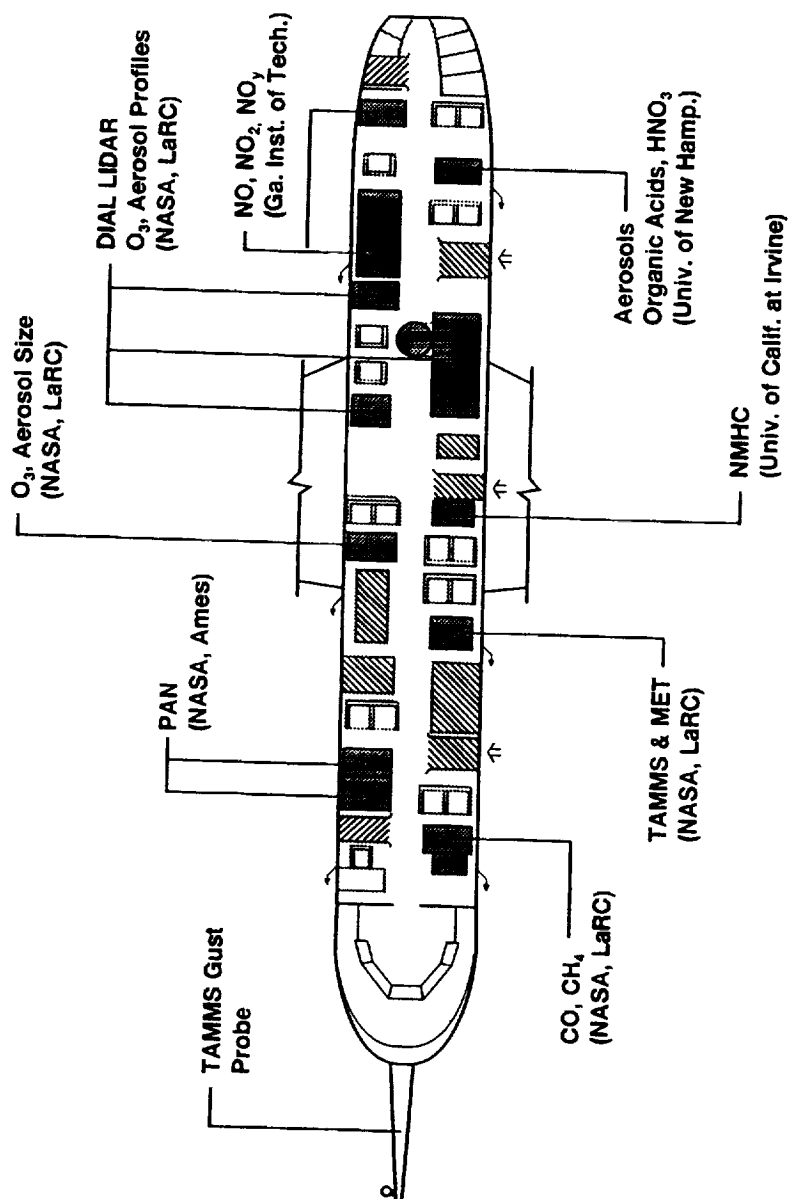


Figure 5: NASA Research Aircraft and the Location of Instrumentation During ABLE-3B





## INTRODUCTION TO APPENDICES

Plots are presented in a standardized format, and the data (unedited) are from the GTE Project archive. Relative humidity and potential temperature have been calculated from the archived data as early GTE missions did not archive these data. In some cases (mostly for moist, boundary layer conditions) relative humidity exceeds 100% (not plotted) as dew point temperature exceeded air temperature by a few degrees (assumed to be the result of instrument measurement/calibration uncertainty). For each expedition and for time series plots, abscissa time scales for a given flight are identical, and ordinate scales (for a given parameter) are identical among all flights. Ordinate scales were selected to best represent all the data from the expedition and for that specie; thus, some data may be off-scale. As a result of the software used for the plots and the data archive use of codes in place of data during calibration, when measurements were at "detection limit" and/or when measurements were made but data invalid, it is sometimes difficult to distinguish from the plots if data are off-scale or missing. For example, a symbol without an attached line may either mean that adjacent data are off-scale or have been coded as invalid. Inspection of the other plotted data often provides information which resolves the uncertainty. For each expedition and for profile plots, all altitude scales are identical and the specie scales are those selected for the time series plots. In order to maintain the standardized format, plots for flights in which a specie data were not reported are plotted with the axes and a "NO DATA" entry.



## APPENDIX A: ABLE-3A DATA

Given below are the beginning page numbers for each flight's sequence of plots:

Flight 1	-	page 26
Flight 2	-	page 30
Flight 3	-	page 34
Flight 4	-	page 38
Flight 5	-	page 42
Flight 6	-	page 46
Flight 7	-	page 50
Flight 8	-	page 54
Flight 9	-	page 58
Flight 10	-	page 62
Flight 11	-	page 66
Flight 12	-	page 70
Flight 13	-	page 74
Flight 14	-	page 78
Flight 15	-	page 82
Flight 16	-	page 86
Flight 17	-	page 90
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Flight 22	-	page 110
Flight 23	-	page 114
Flight 24	-	page 118
Flight 25	-	page 122
Flight 26	-	page 126
Flight 27	-	page 129
Flight 28	-	page 133
Flight 29	-	page 137
Flight 30	-	page 141
Flight 31	-	page 146
Flight 32	-	page 150
Flight 33	-	page 154

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ABLE-3A ALASKAN MISSION: FLIGHT 1.

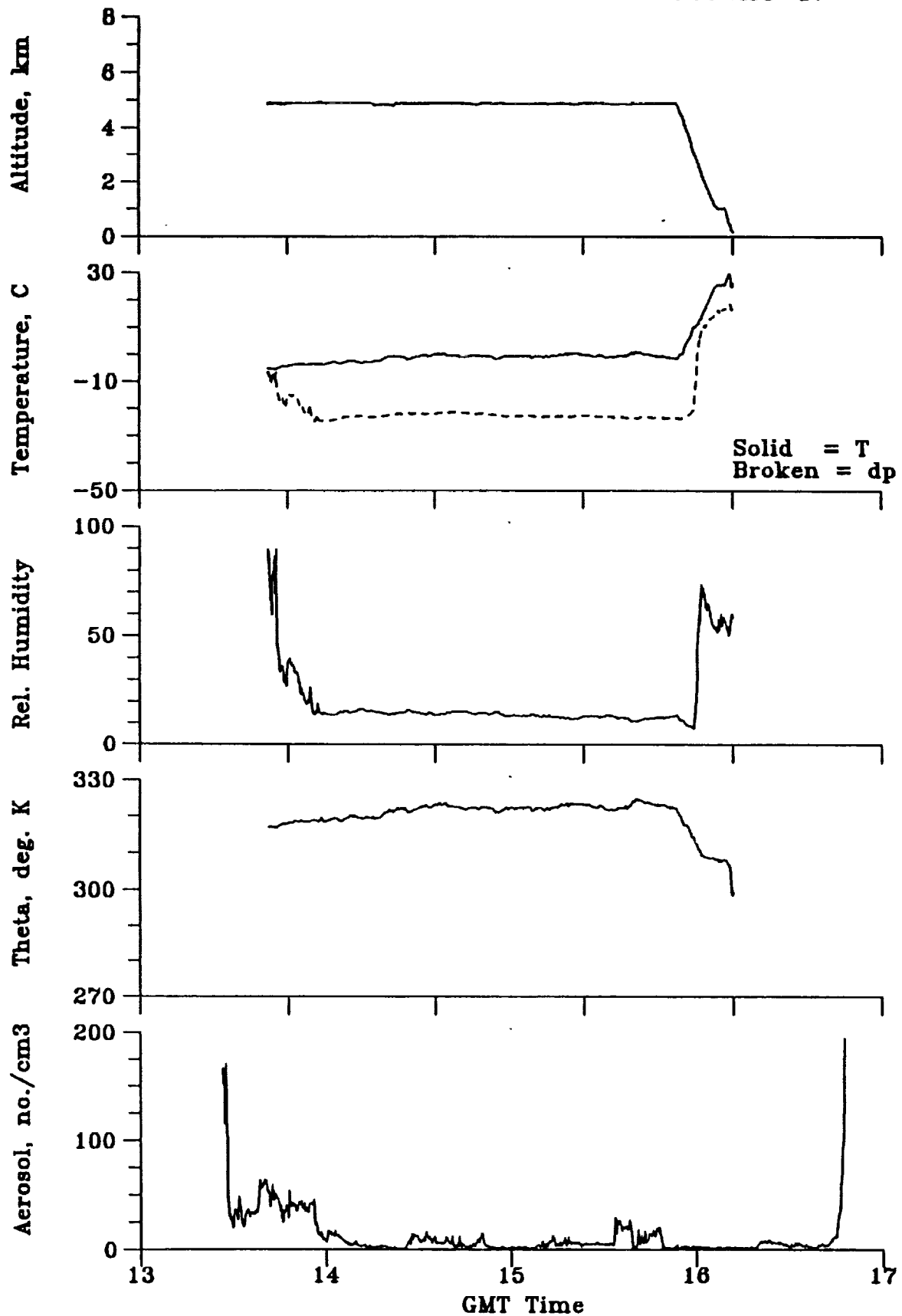


Figure A1.1

# ABLE-3A ALASKAN MISSION: FLIGHT 1.

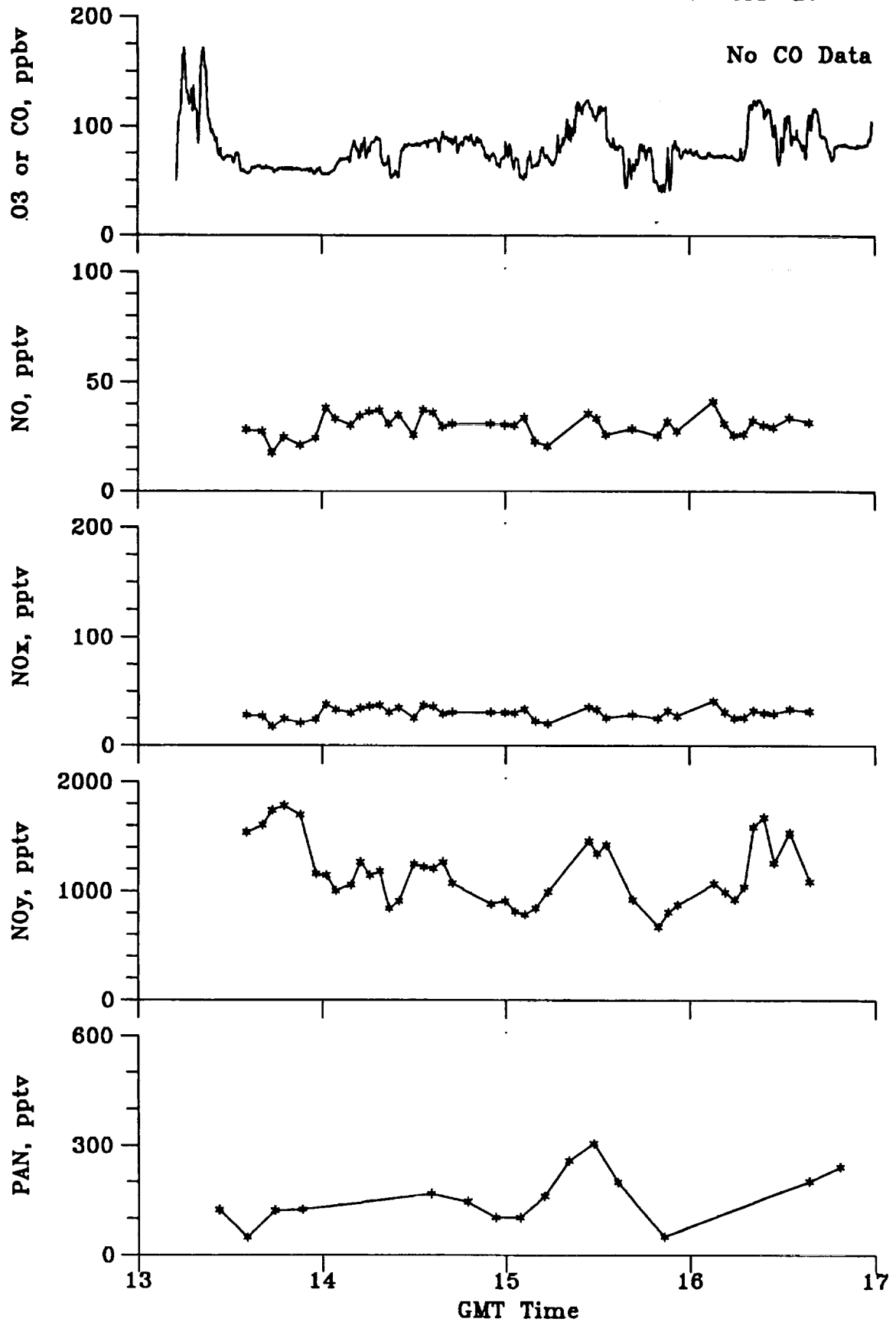


Figure A1.2

# ABLE-3A ALASKAN MISSION: FLIGHT 1.

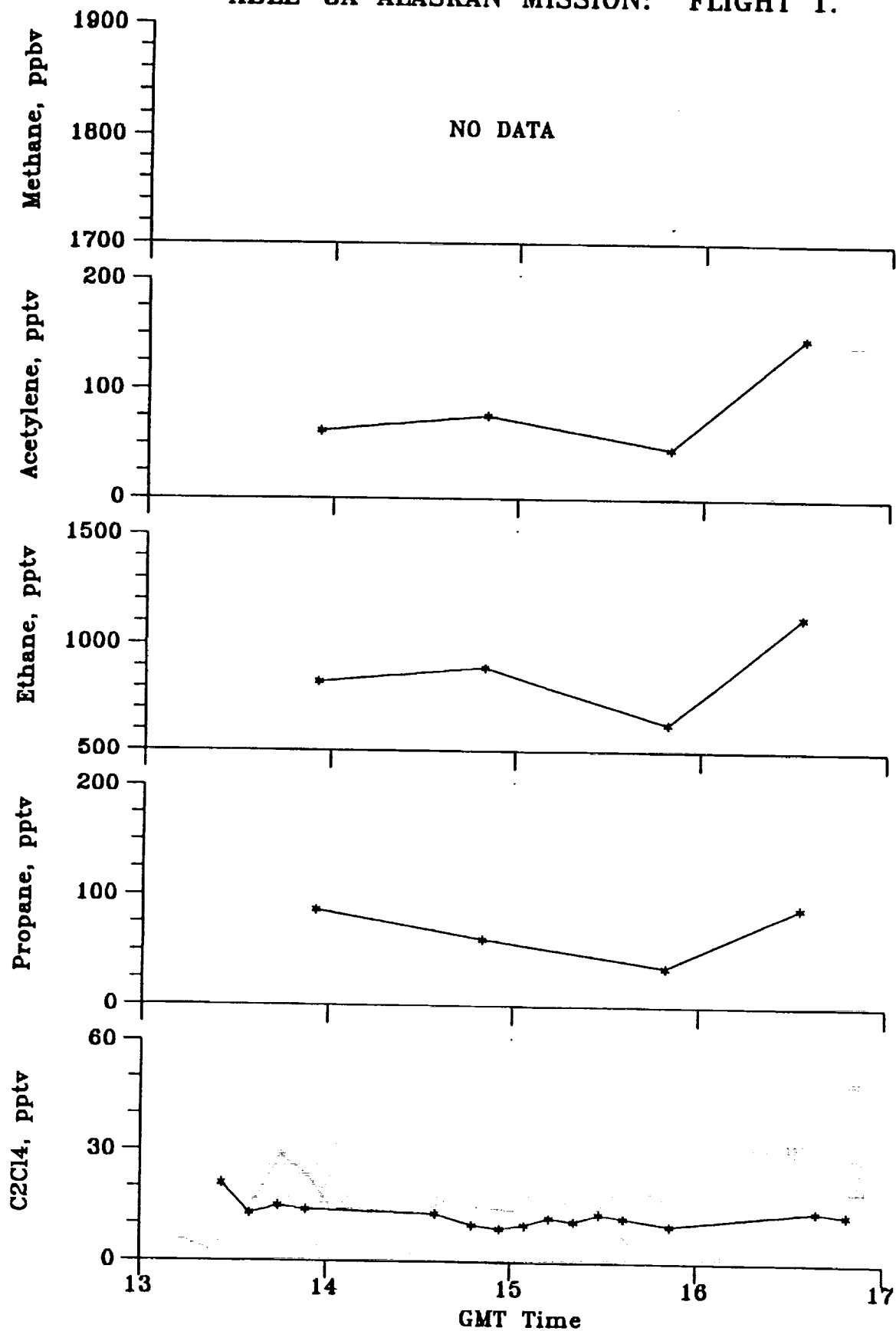


Figure A1.3

ABLE-3A ALASKAN MISSION: FLIGHT 1 PROFILE AT 1645 GMT

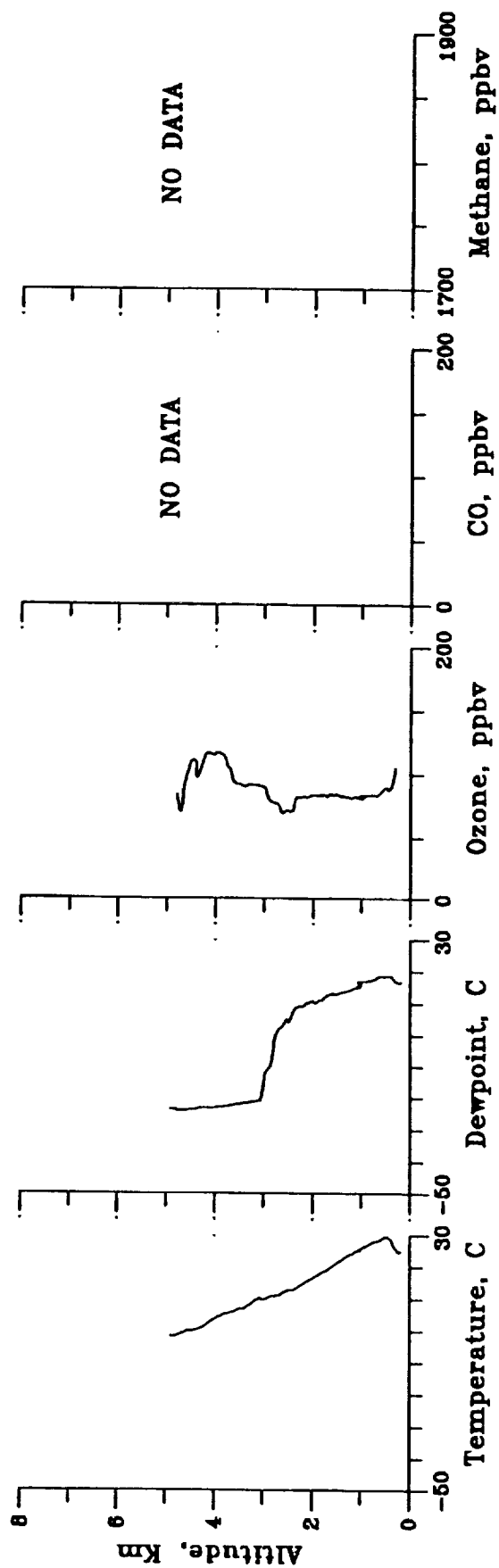


Figure A1.4

ABLE-3A ALASKAN MISSION: FLIGHT 2.

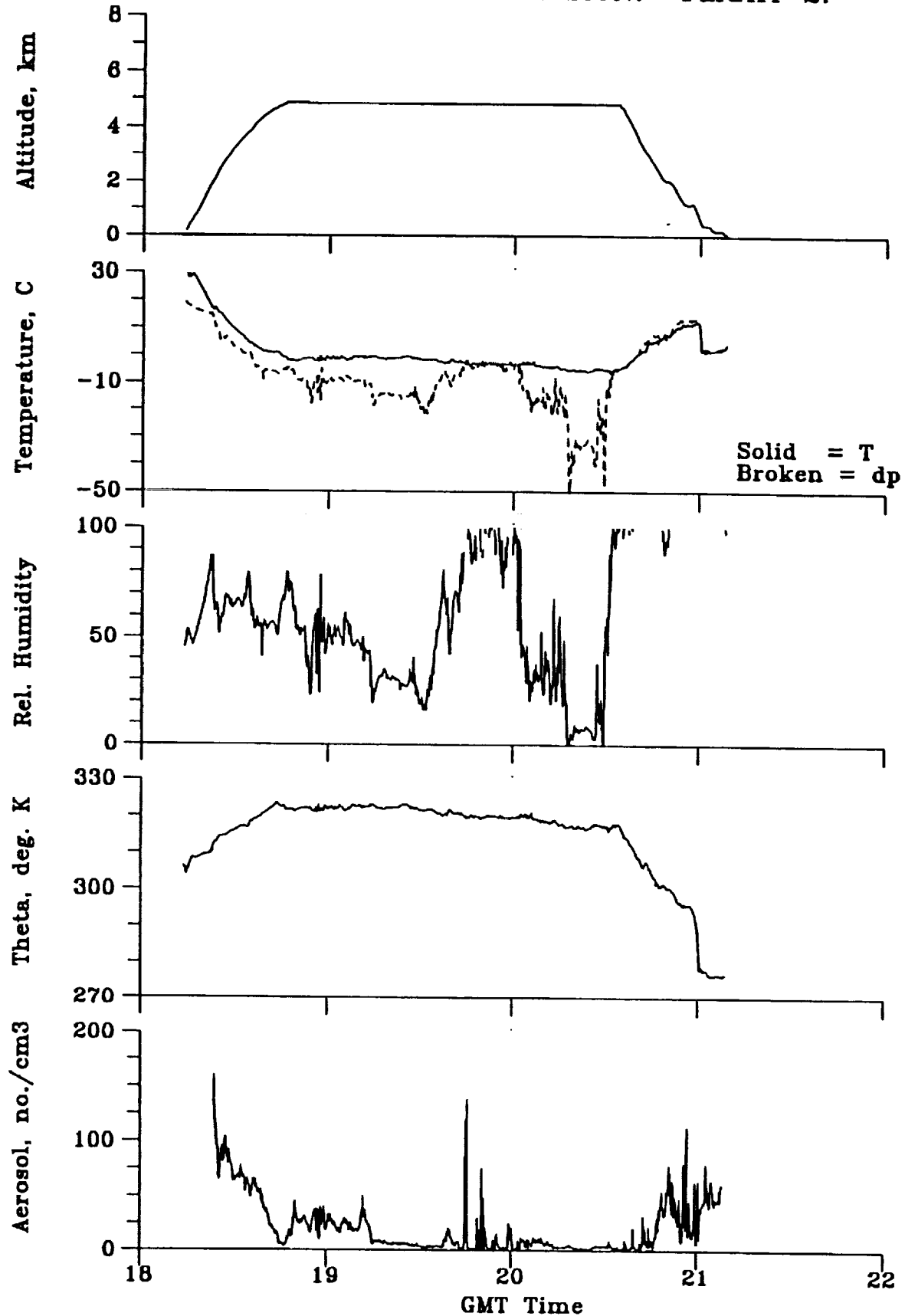


Figure A2.1



# ABLE-3A ALASKAN MISSION: FLIGHT 2.

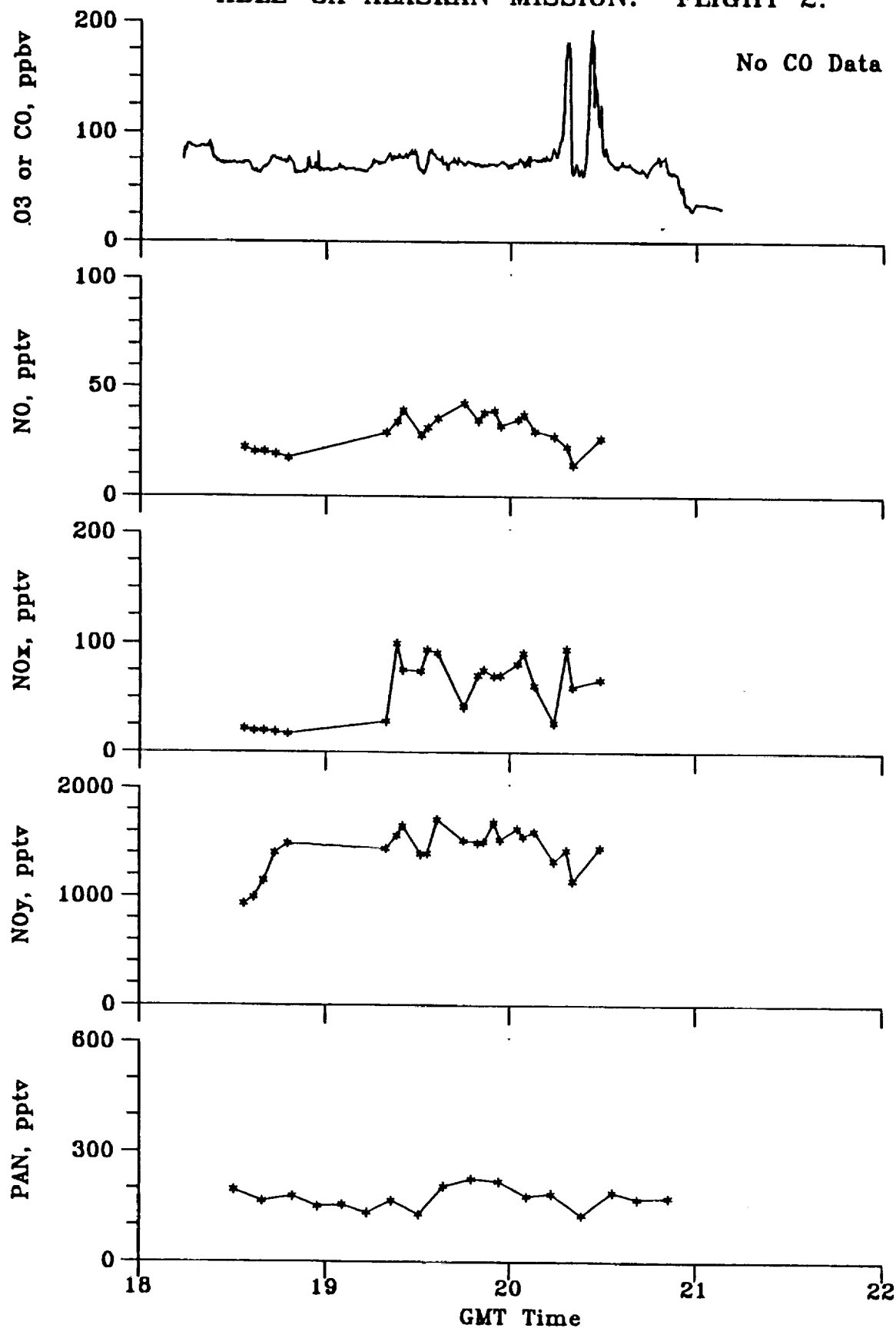


Figure A2.2

# ABLE-3A ALASKAN MISSION: FLIGHT 2.

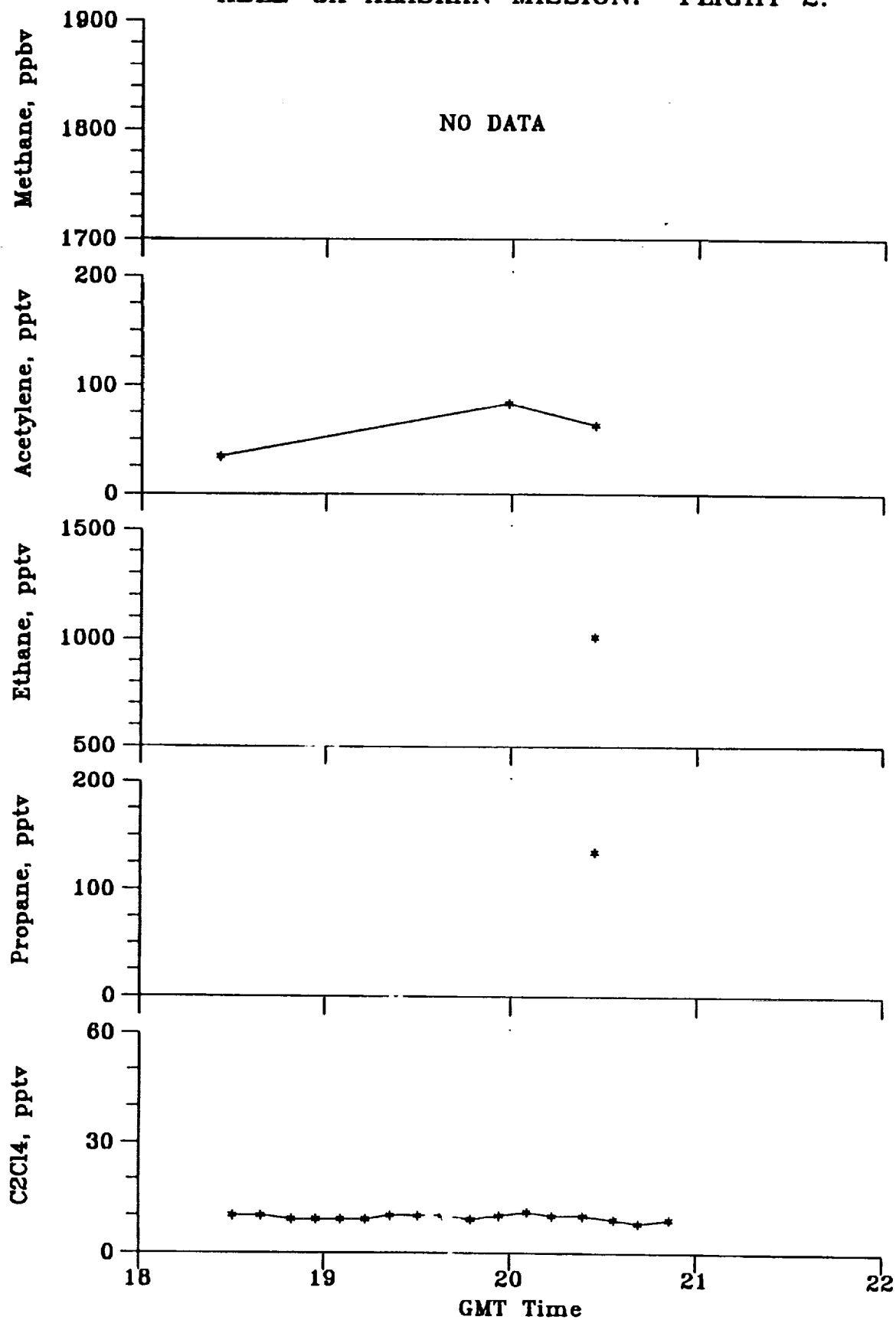
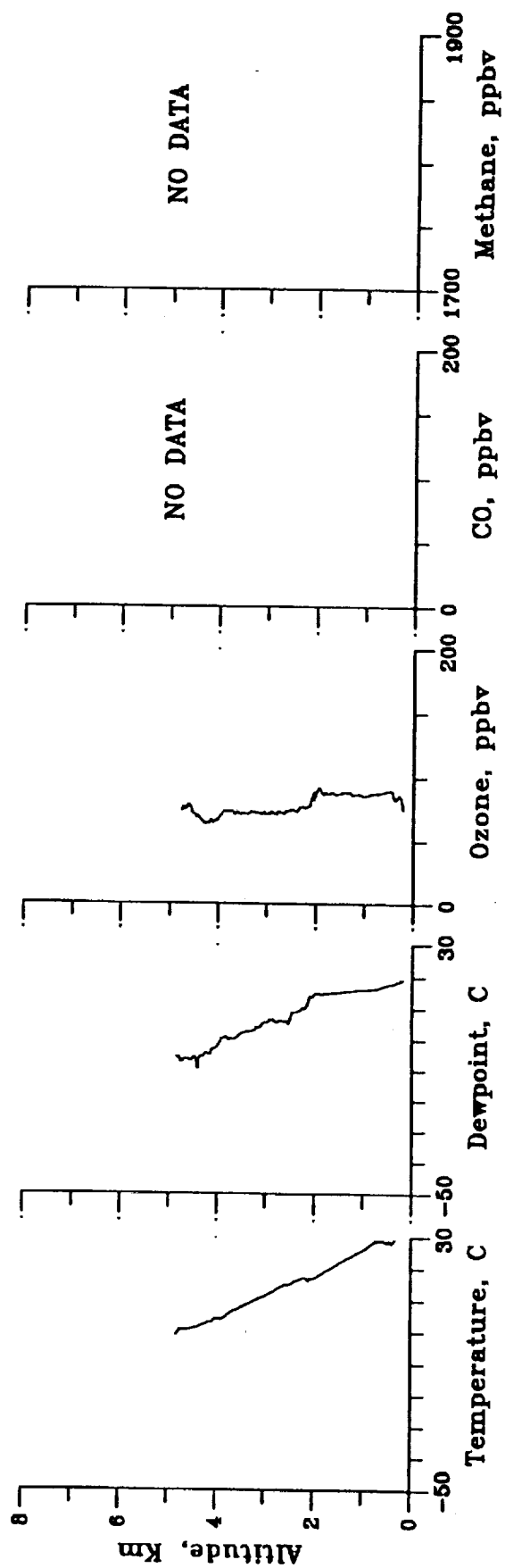


Figure A2.3

ABLE-3A ALASKAN MISSION: FLIGHT 2 PROFILE AT 1830 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 2 PROFILE AT 2100 GMT

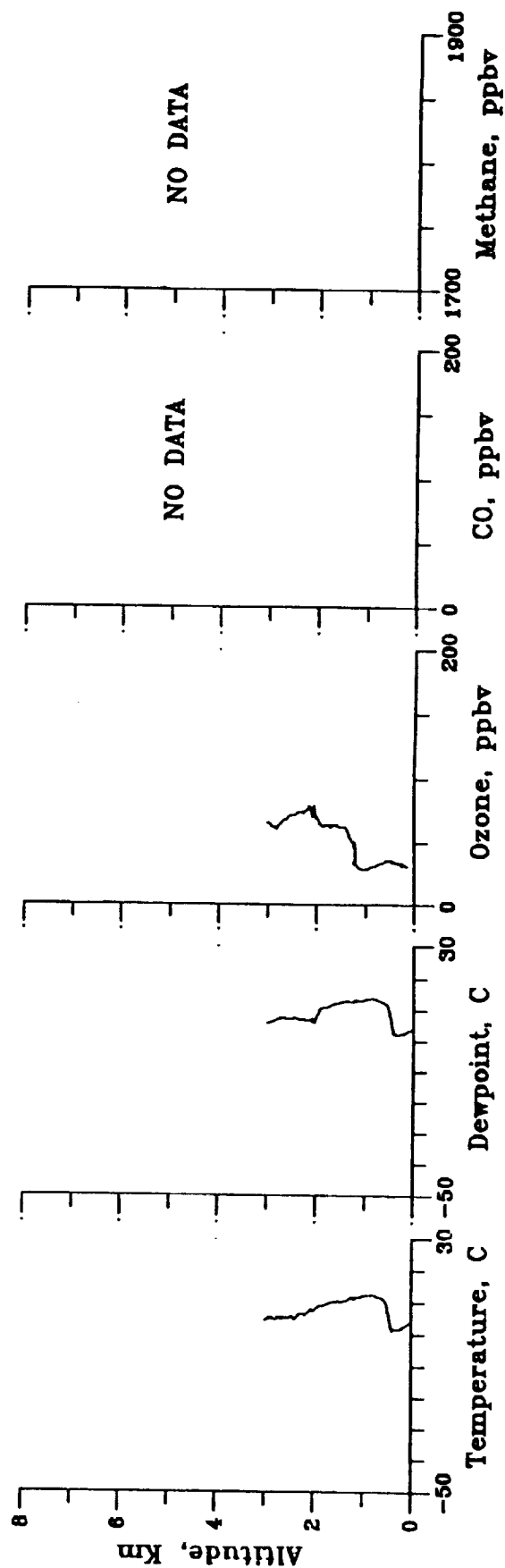


Figure A2.4

ABLE-3A ALASKAN MISSION: FLIGHT 3.

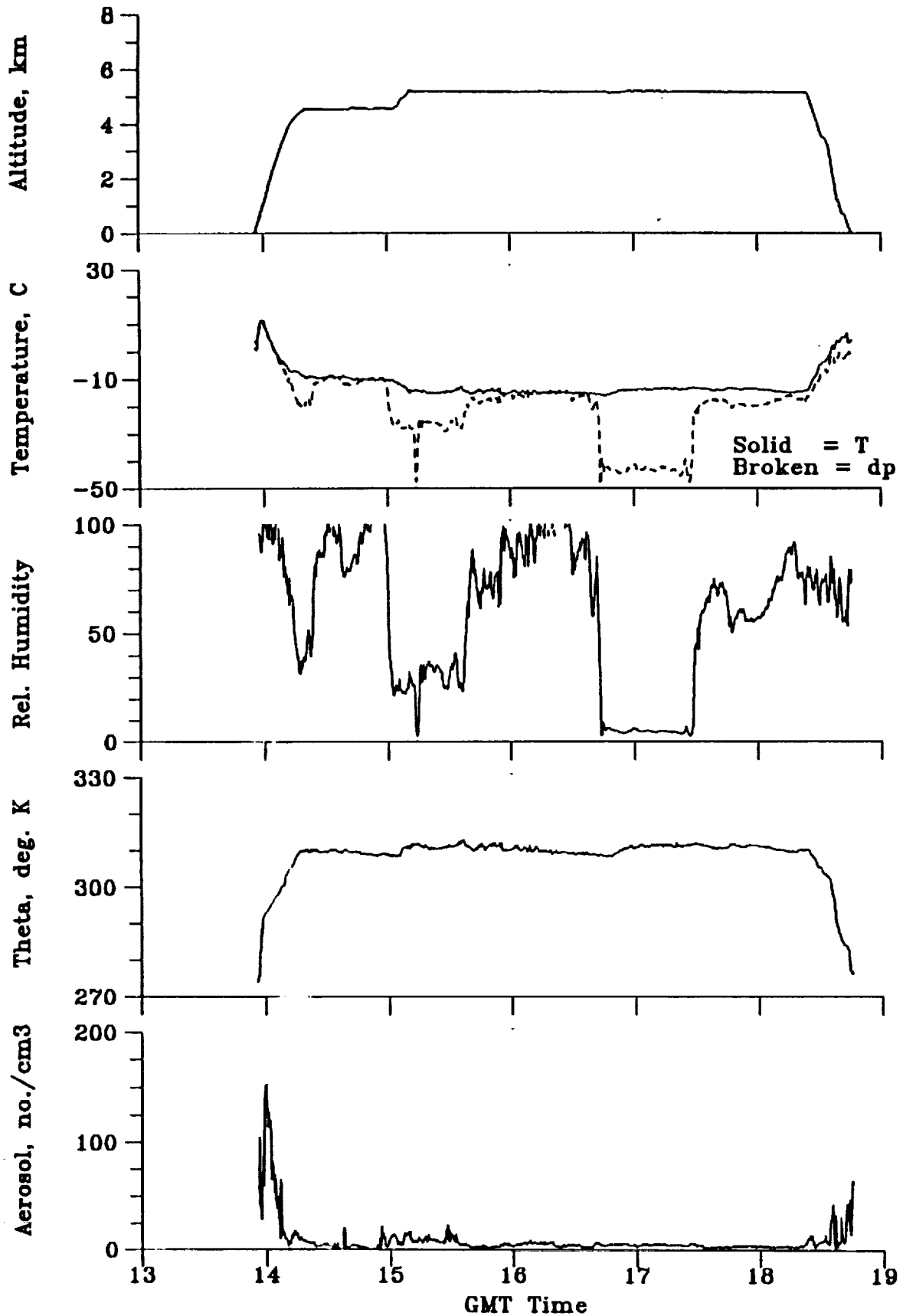


Figure A3.1

ABLE-3A ALASKAN MISSION: FLIGHT 3.

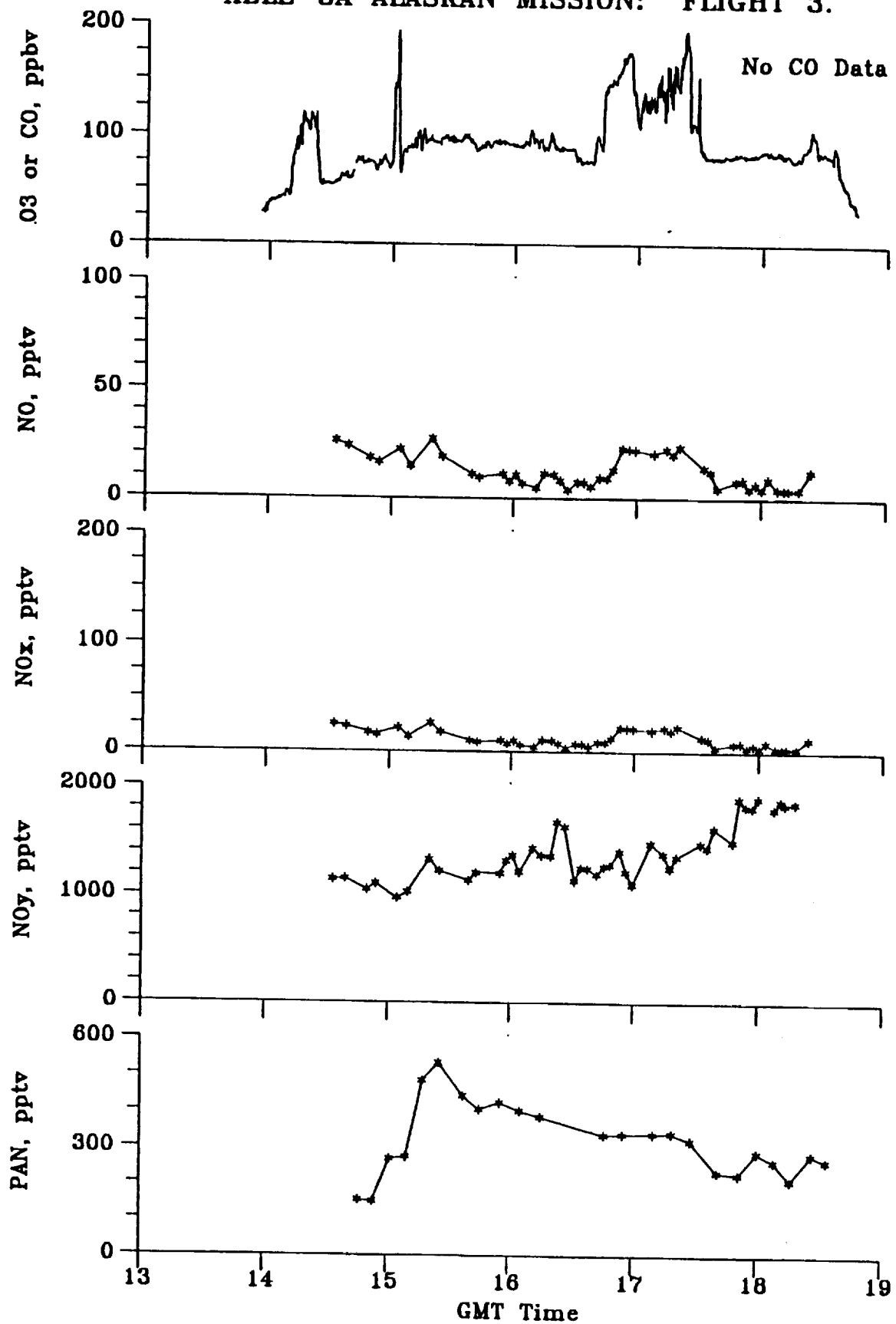


Figure A3.2

# ABLE-3A ALASKAN MISSION: FLIGHT 3.

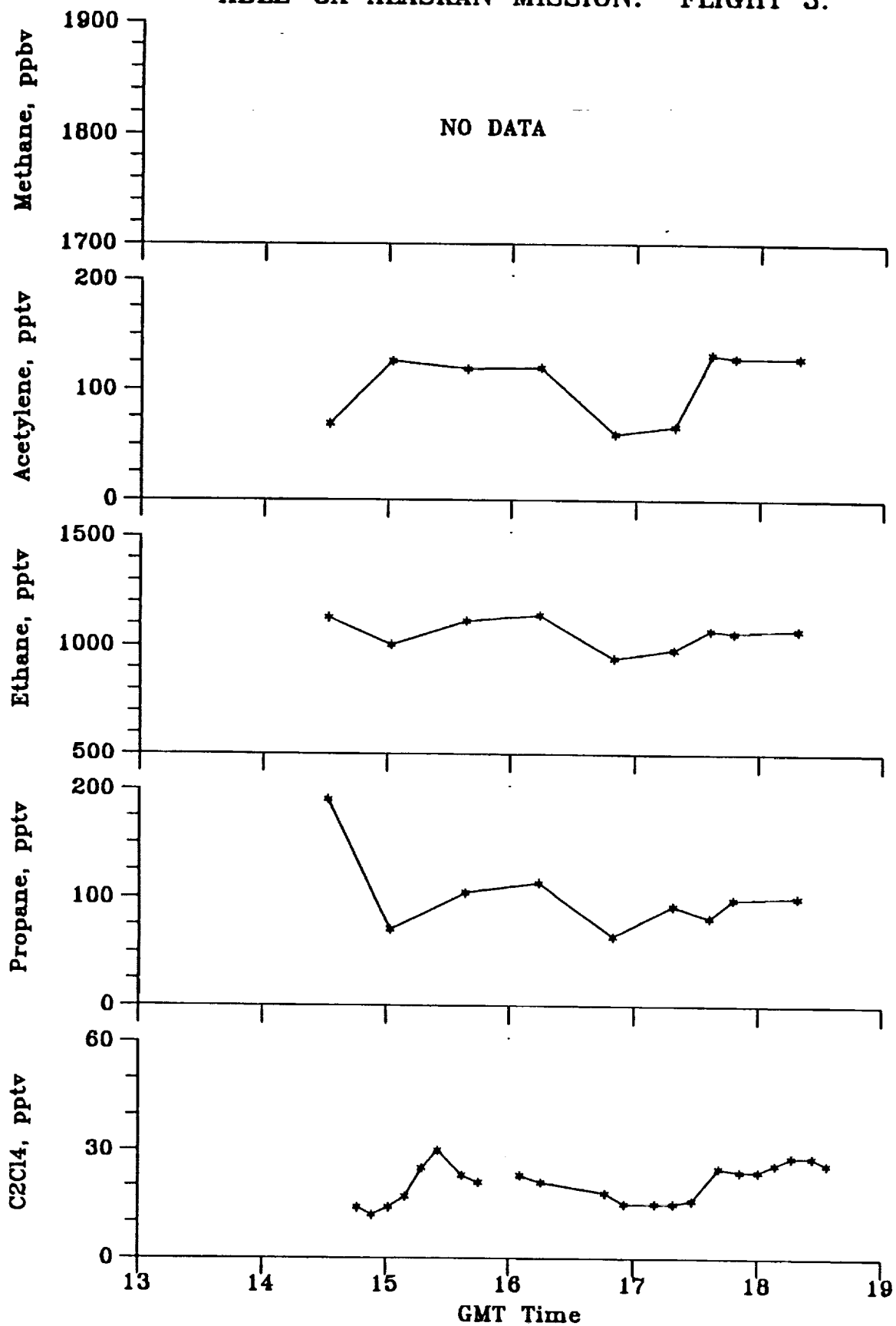
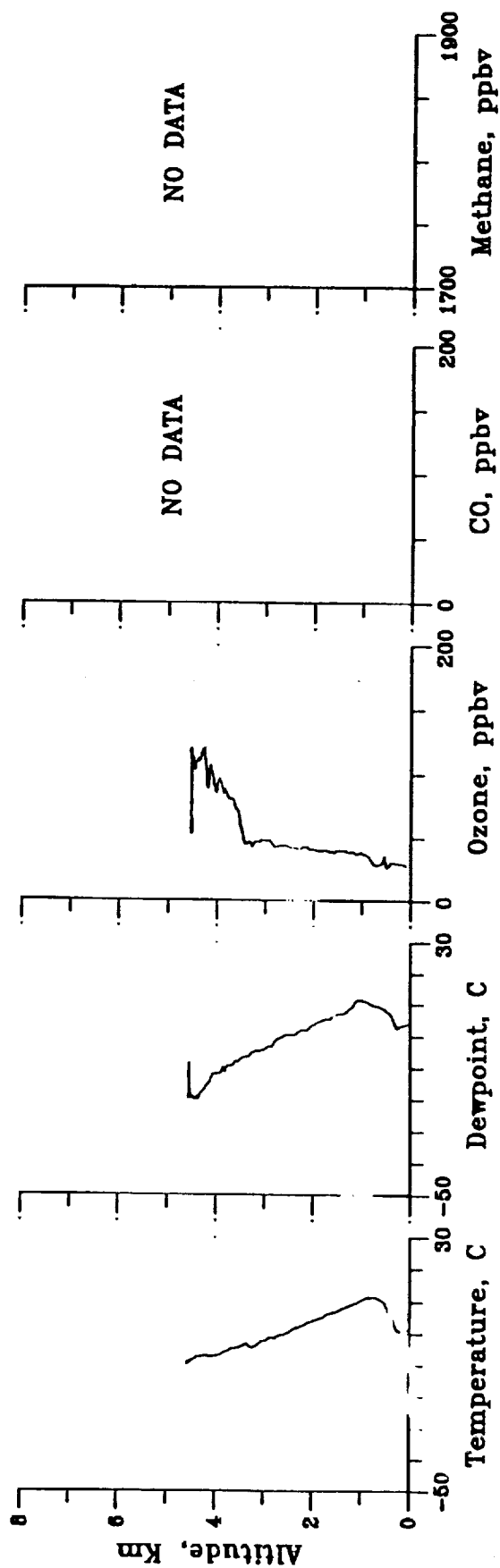


Figure A3.3

ABLE-3A ALASKAN MISSION: FLIGHT 3 PROFILE AT 1415 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 3 PROFILE AT 1830 GMT

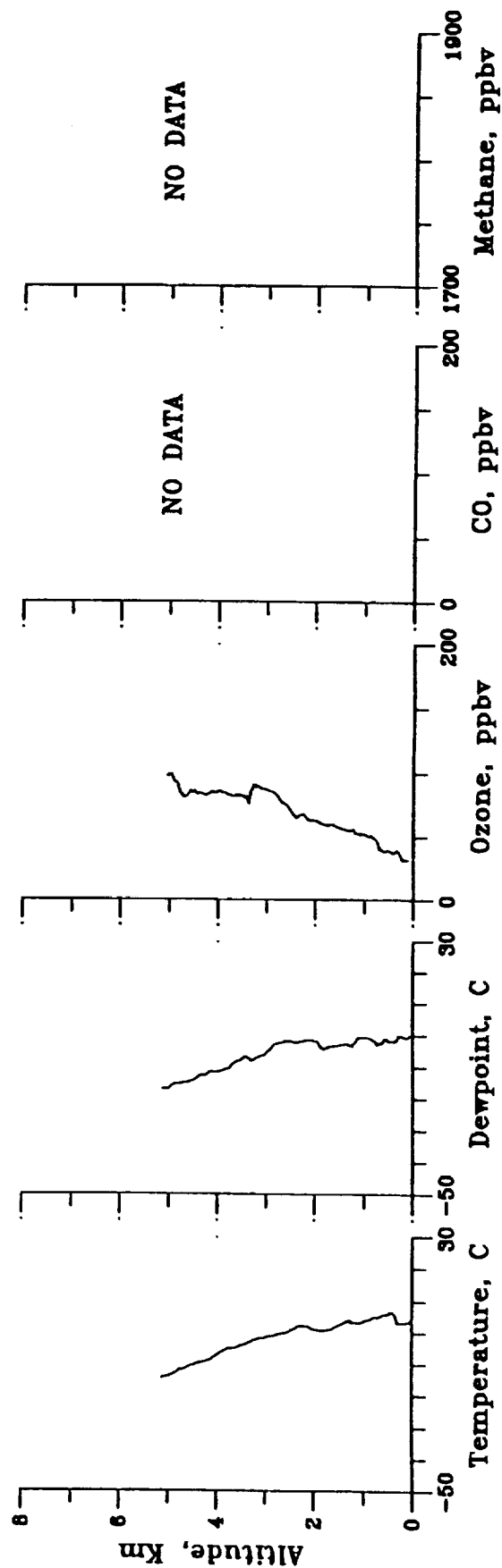


Figure A3.4

# ABLE-3A ALASKAN MISSION: FLIGHT 4.

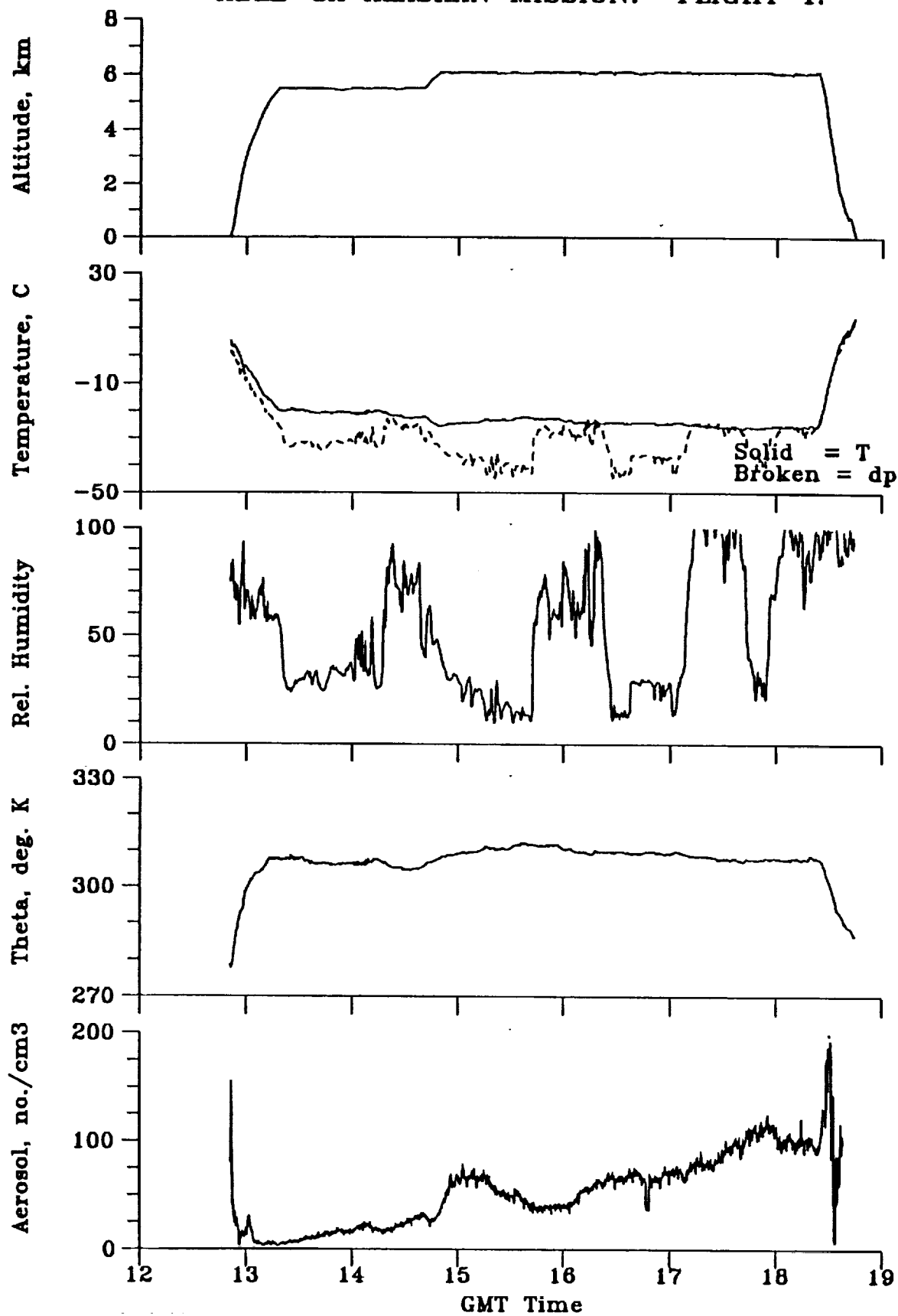


Figure A4.1



ABLE-3A ALASKAN MISSION: FLIGHT 4.

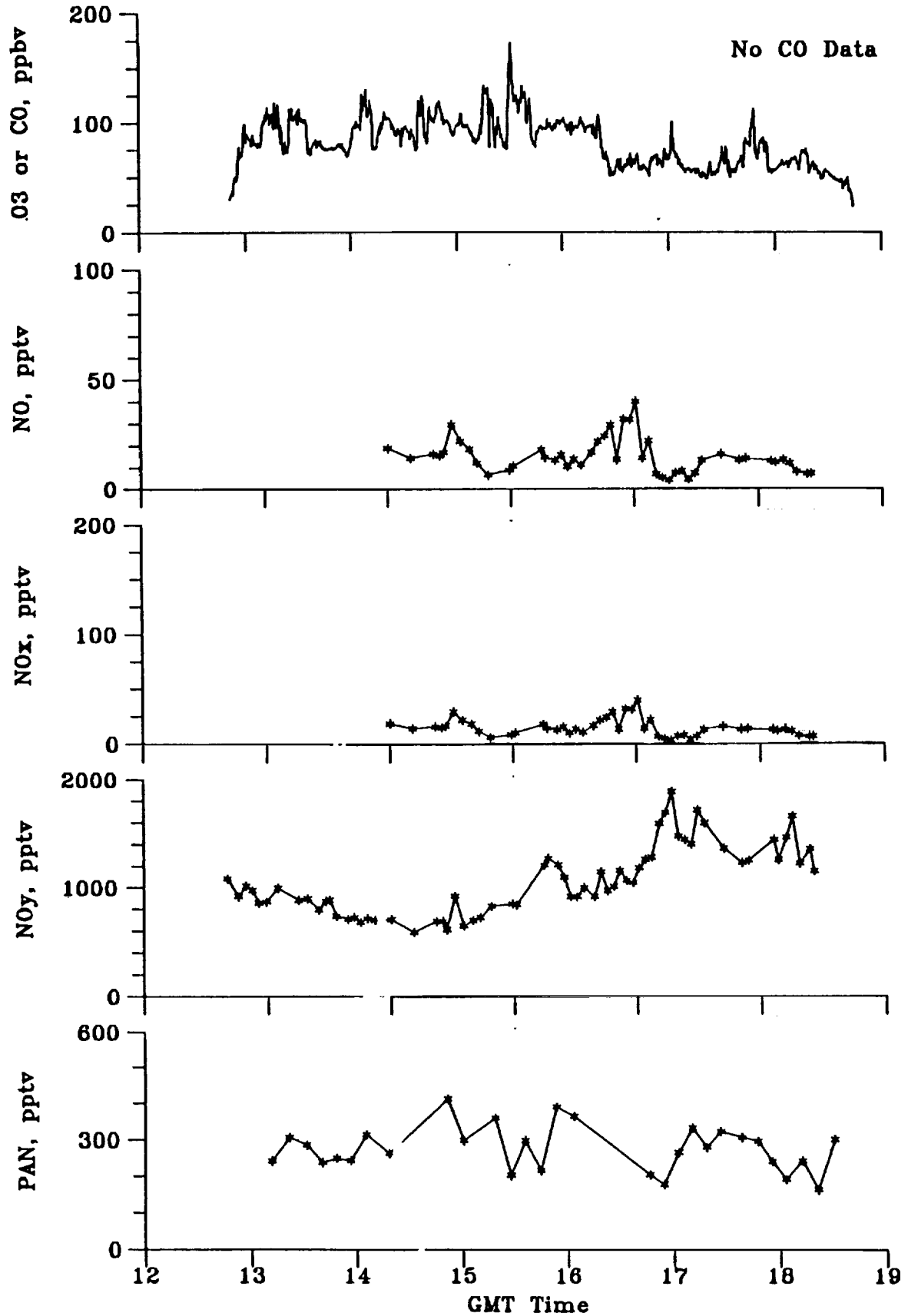


Figure A4.2

# ABLE-3A ALASKAN MISSION: FLIGHT 4.

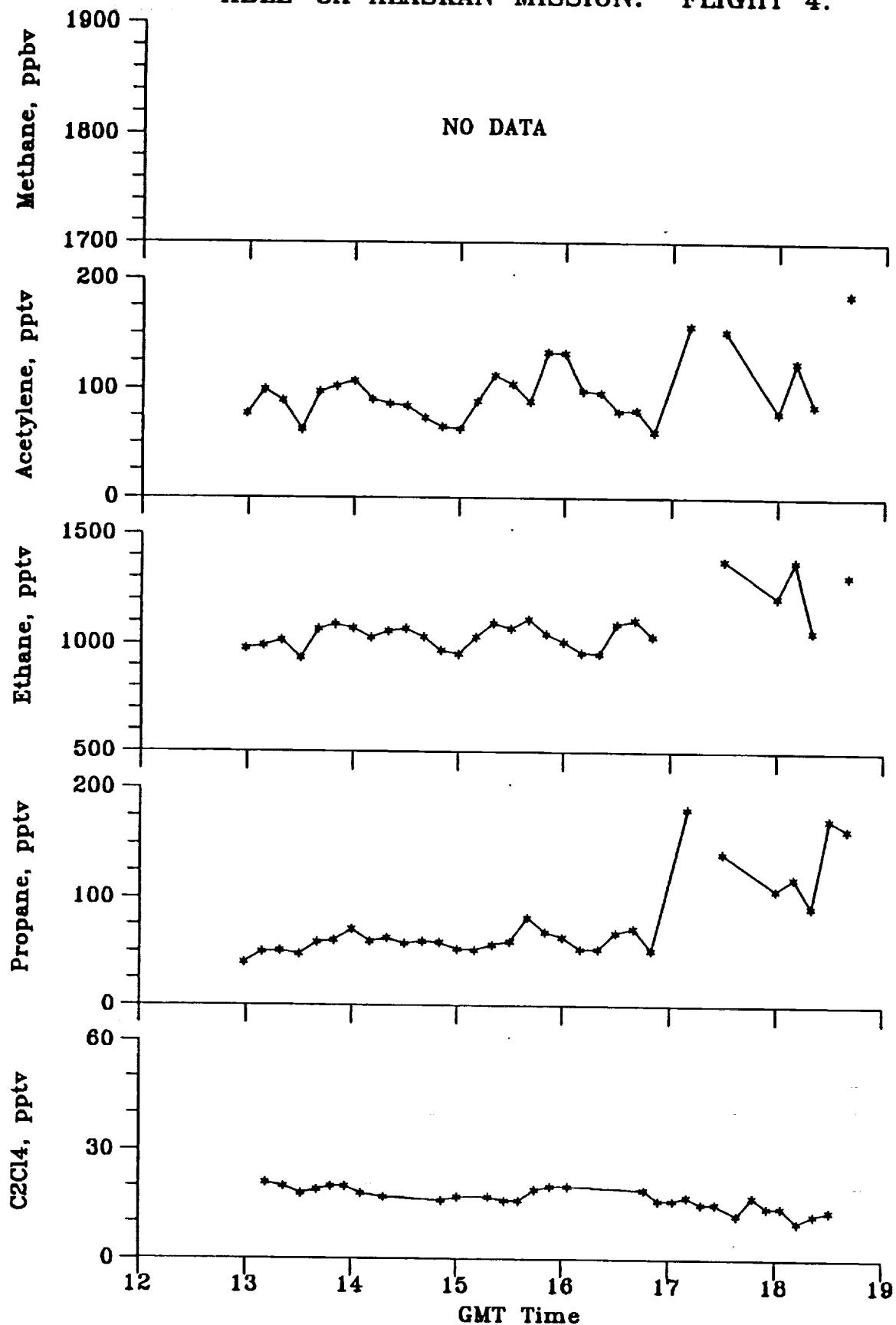
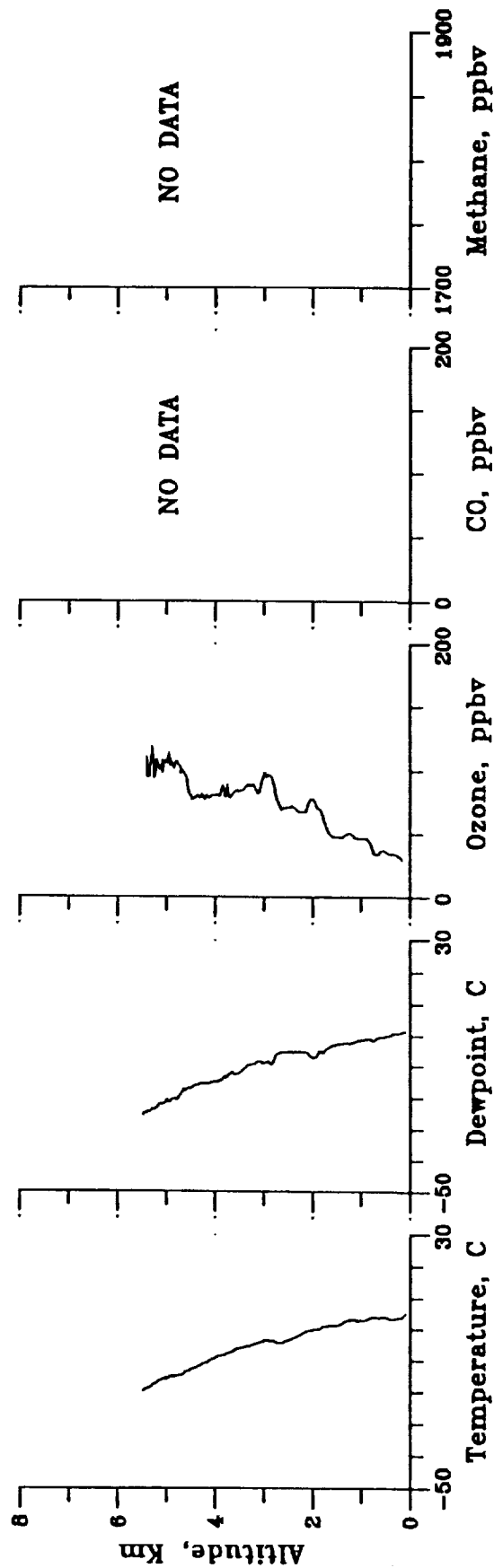


Figure A4.3

ABLE-3A ALASKAN MISSION: FLIGHT 4 PROFILE AT 1300 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 4 PROFILE AT 1830 GMT

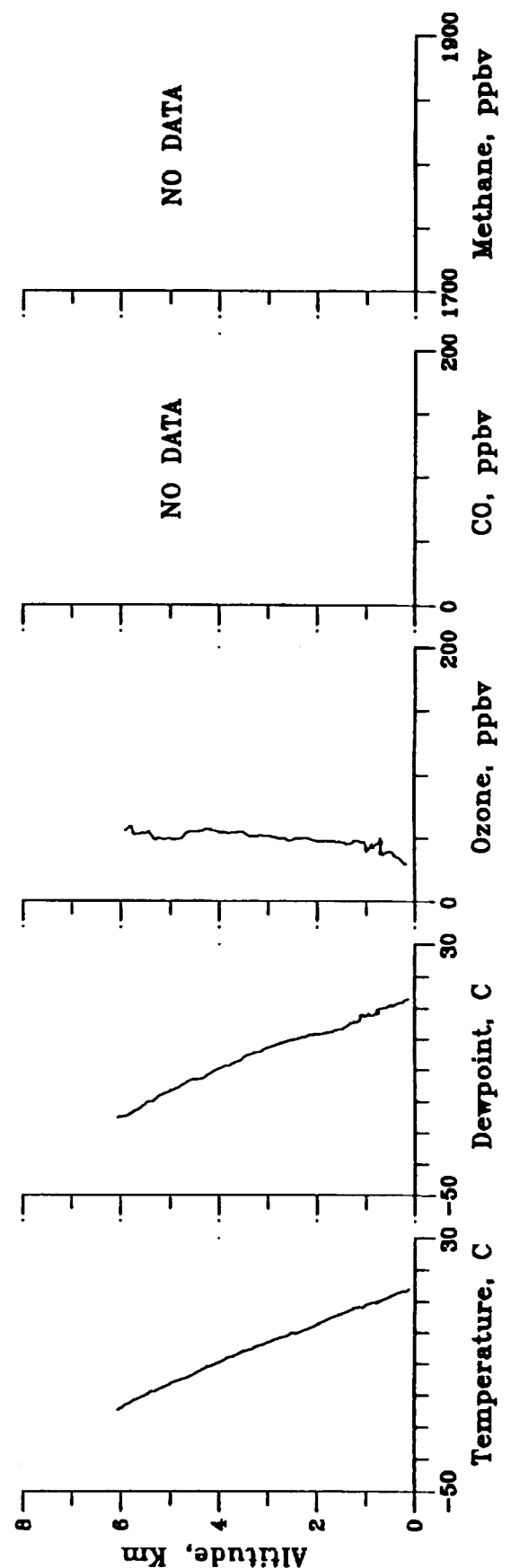


Figure A4.4

ABLE-3A ALASKAN MISSION: FLIGHT 5.

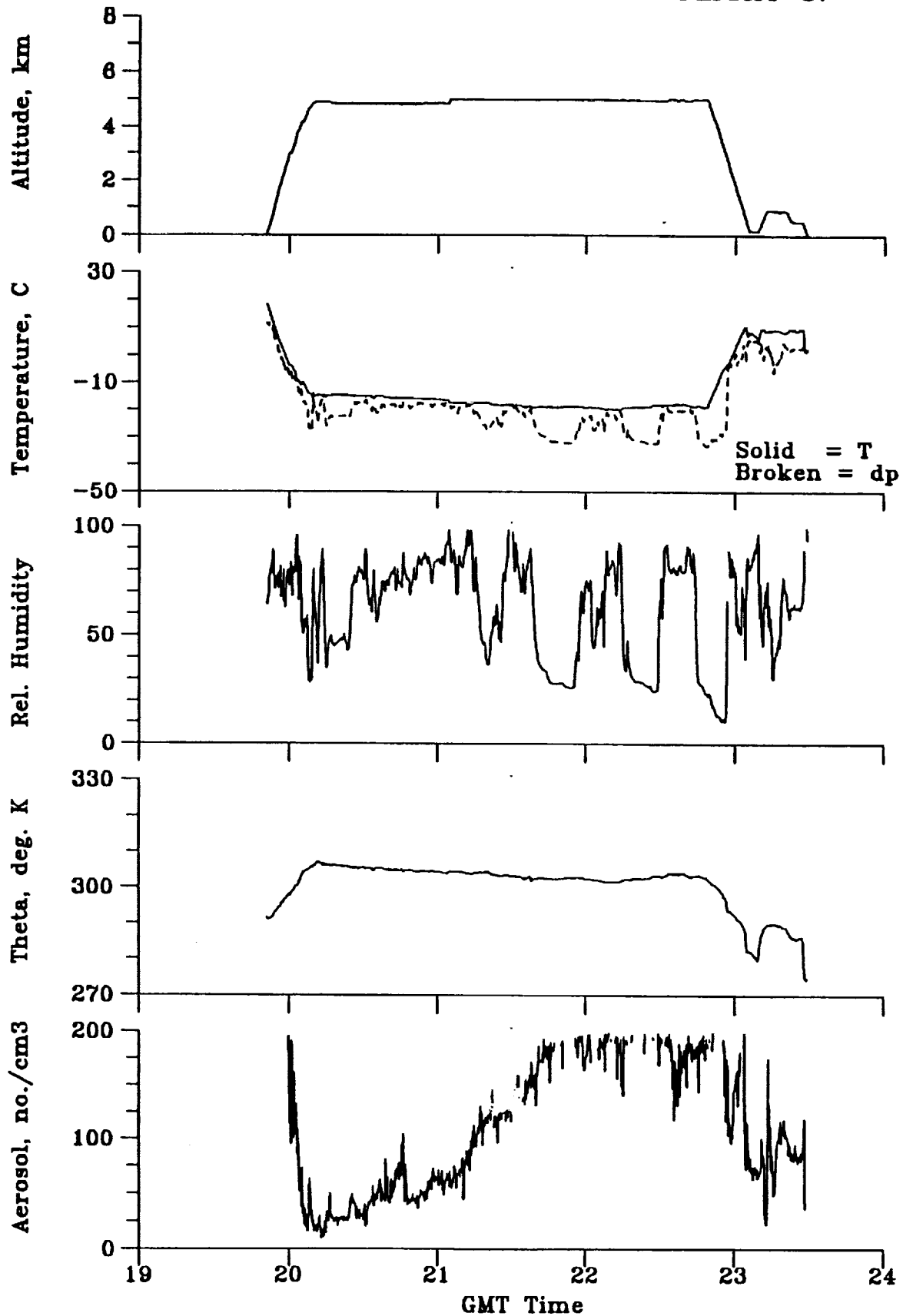


Figure A5.1

# ABLE-3A ALASKAN MISSION: FLIGHT 5.

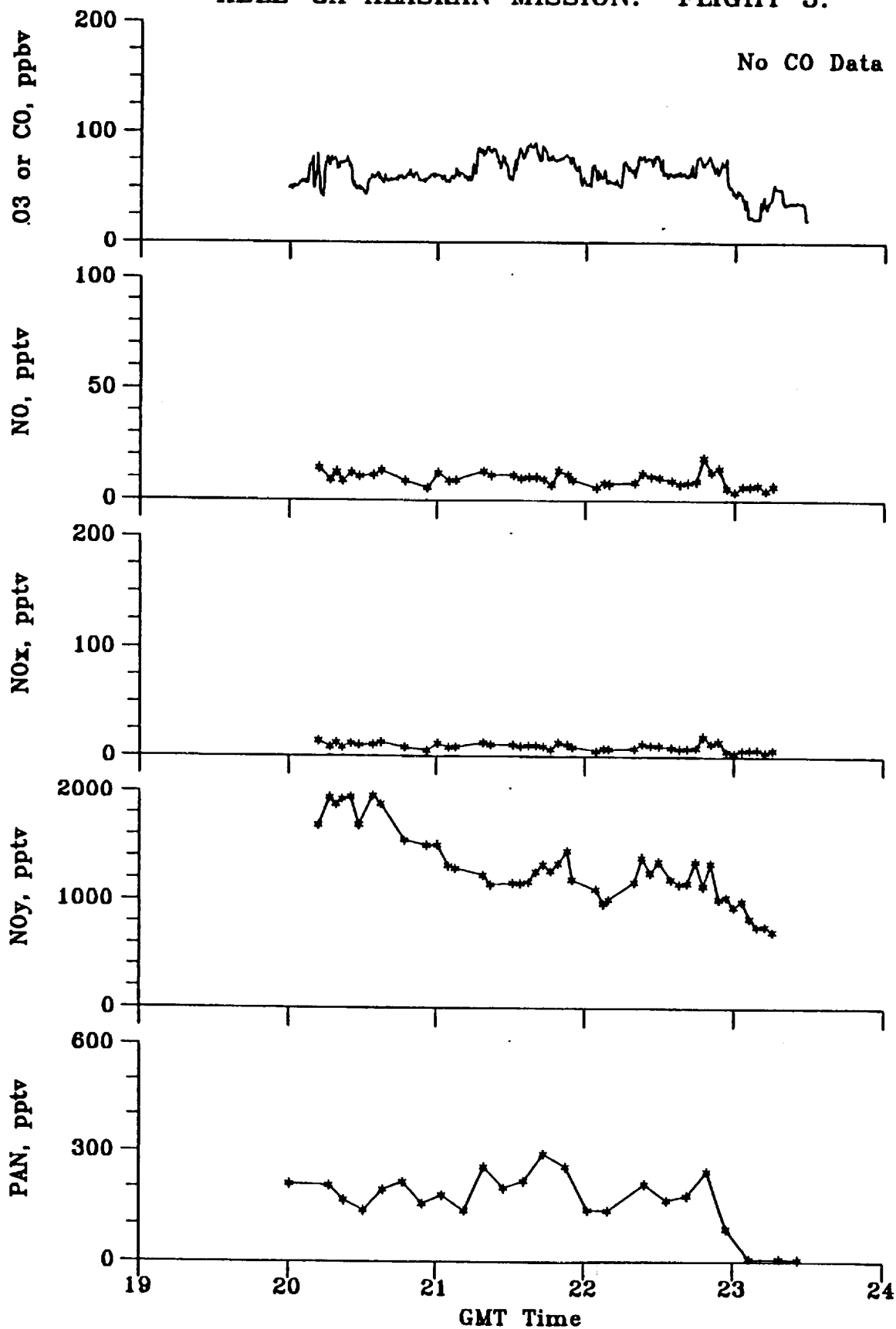


Figure A5.2

# ABLE-3A ALASKAN MISSION: FLIGHT 5.

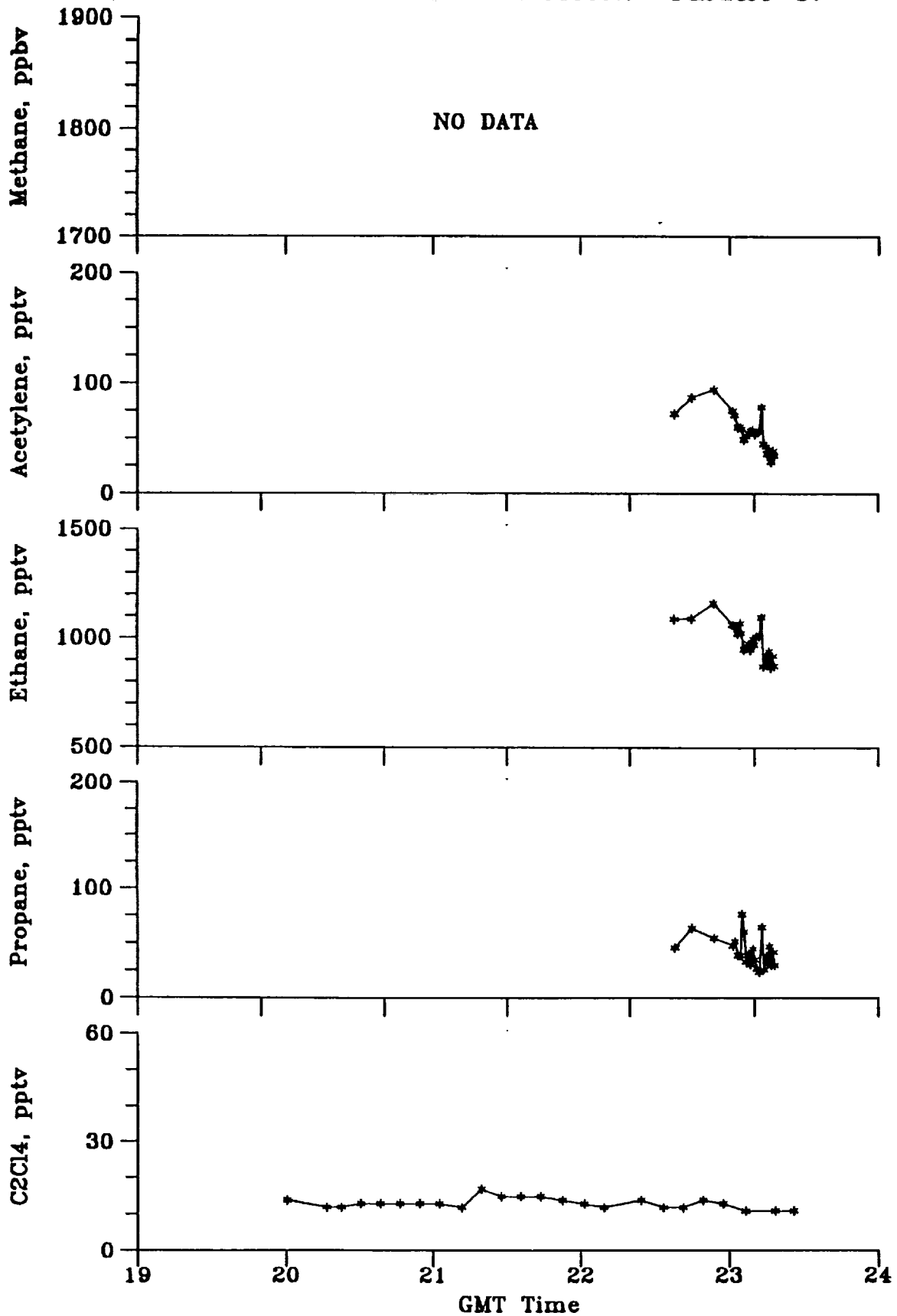


Figure A5.3

ABLE-3A ALASKAN MISSION: FLIGHT 5 PROFILE AT 2300 GMT

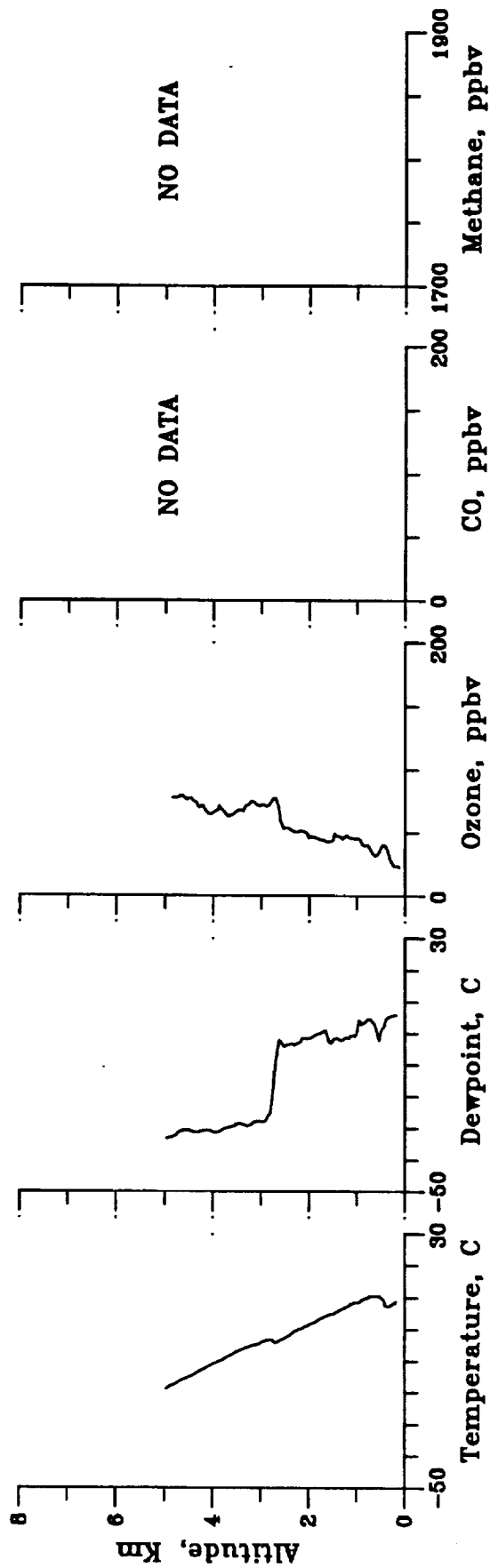


Figure A5.4

# ABLE-3A ALASKAN MISSION: FLIGHT 6.

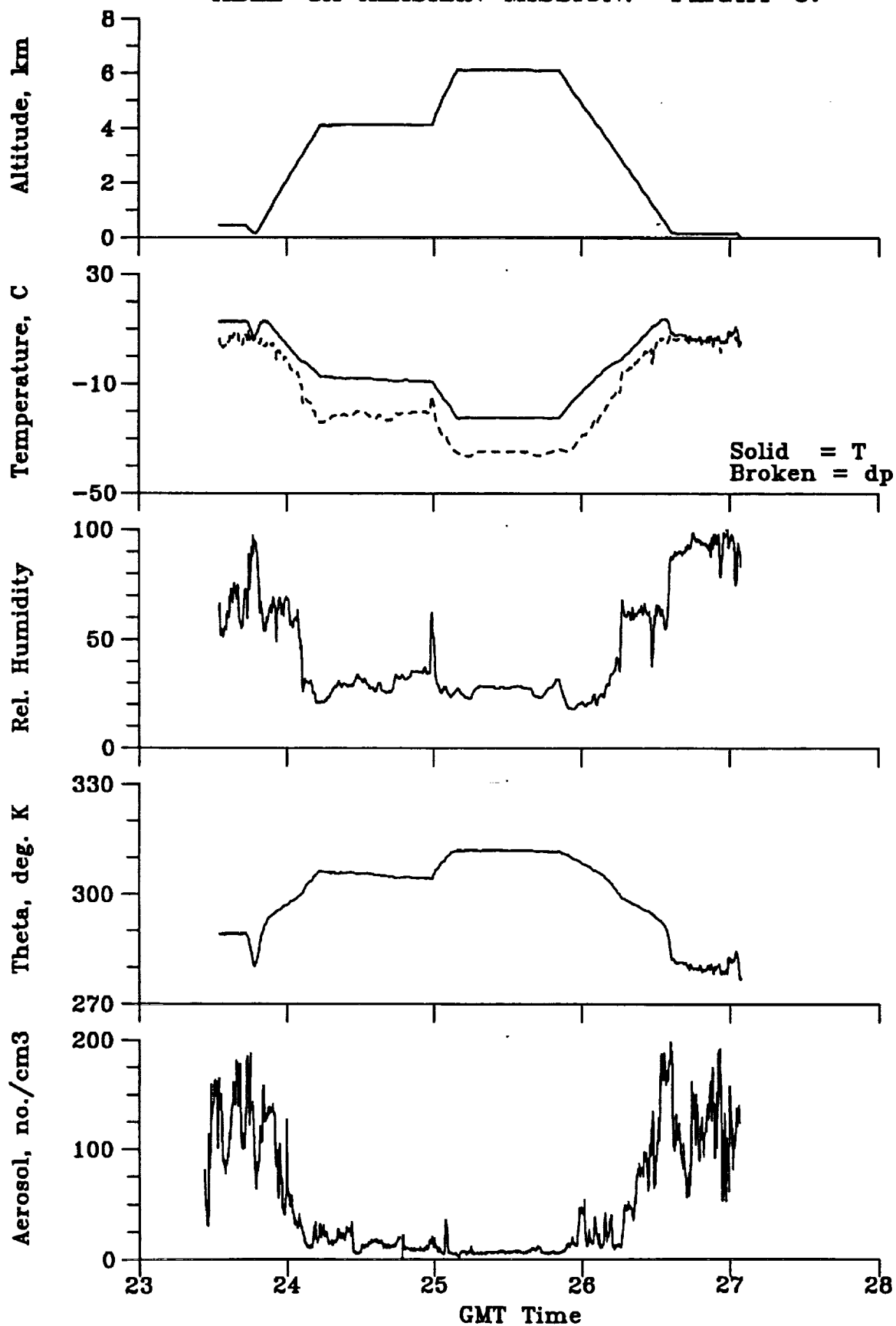


Figure A6.1



# ABLE-3A ALASKAN MISSION: FLIGHT 6.

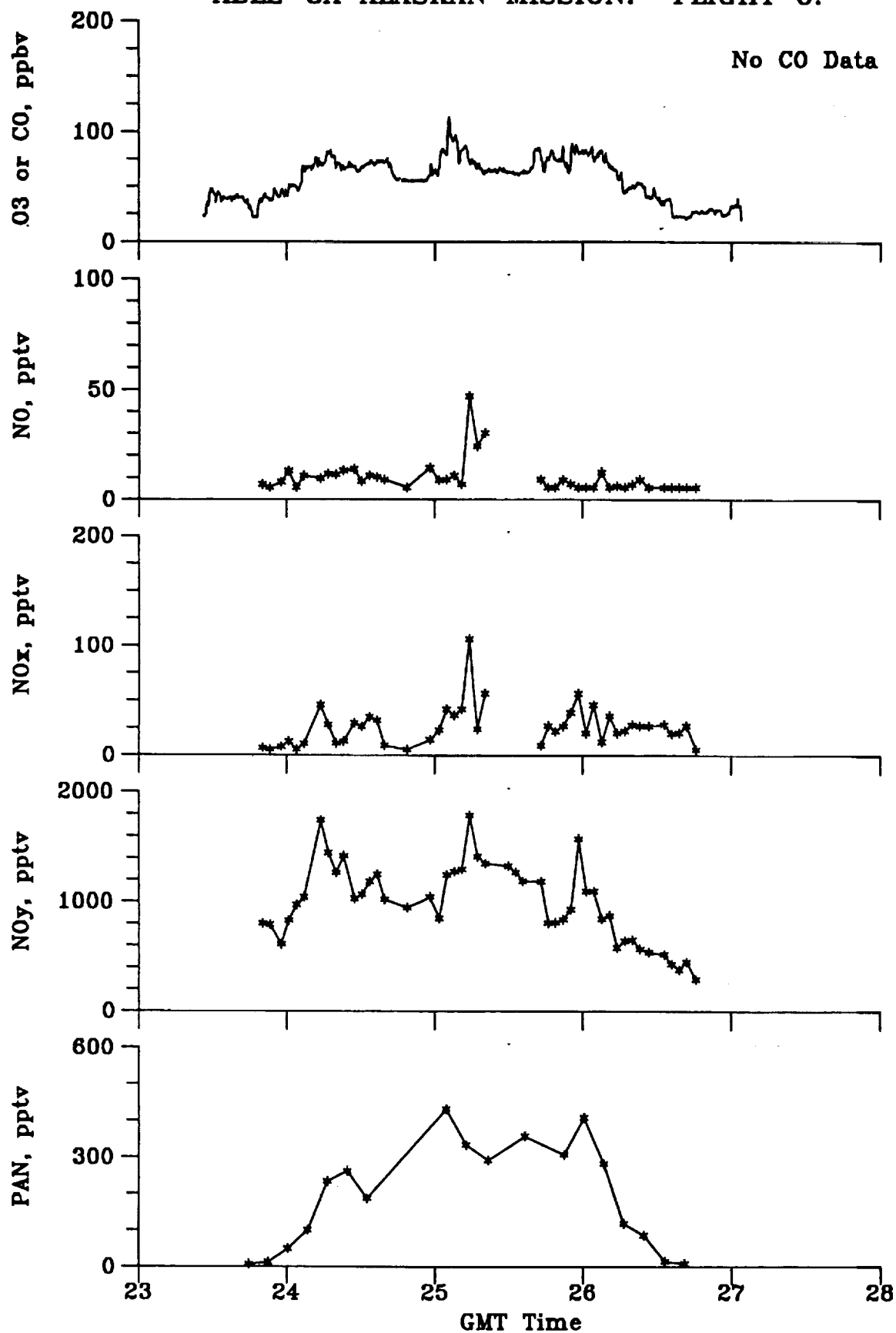


Figure A6.2

ABLE-3A ALASKAN MISSION: FLIGHT 6.

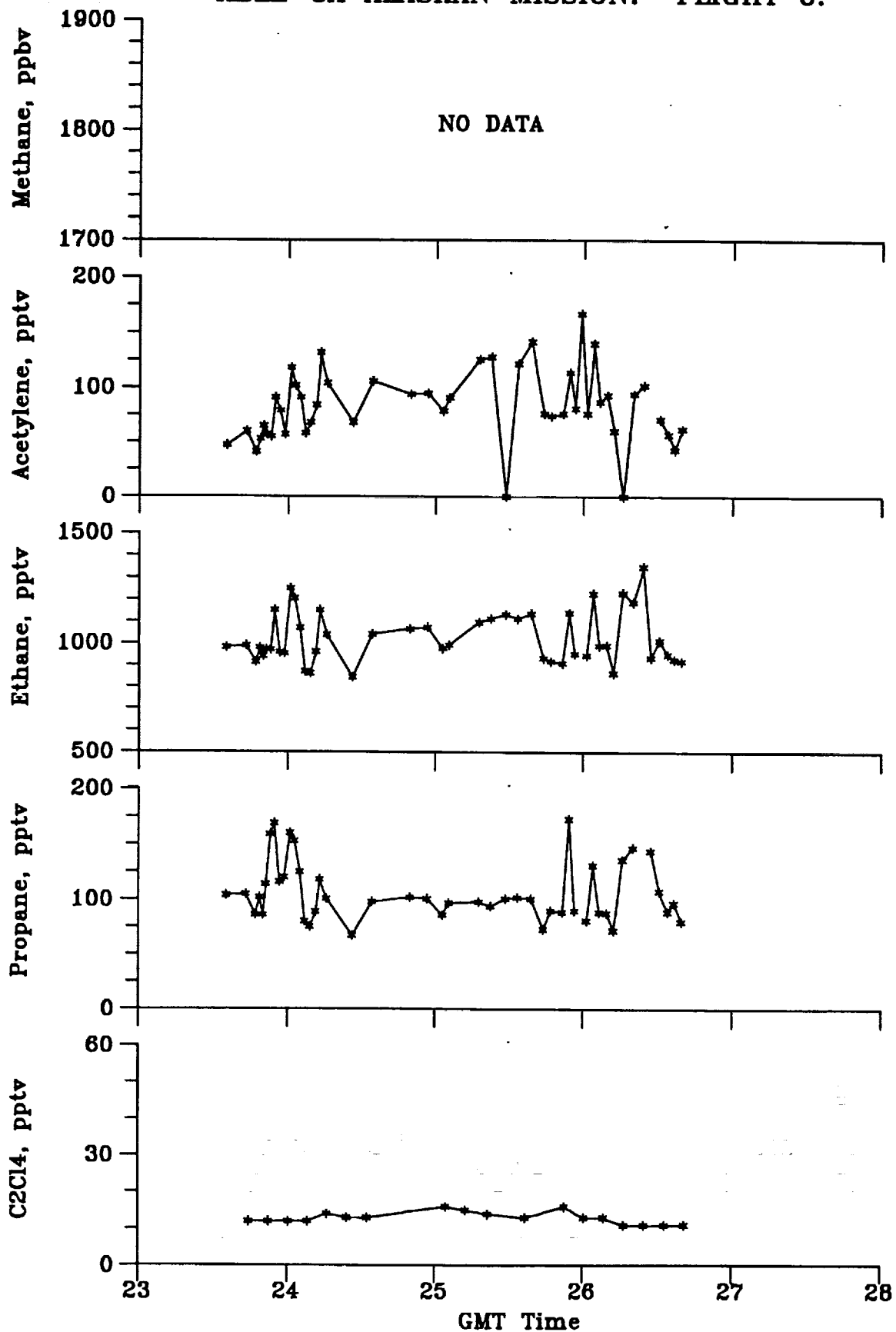


Figure A6.3

ABLE-3A ALASKAN MISSION: FLIGHT 6 PROFILE AT 0215 GMT

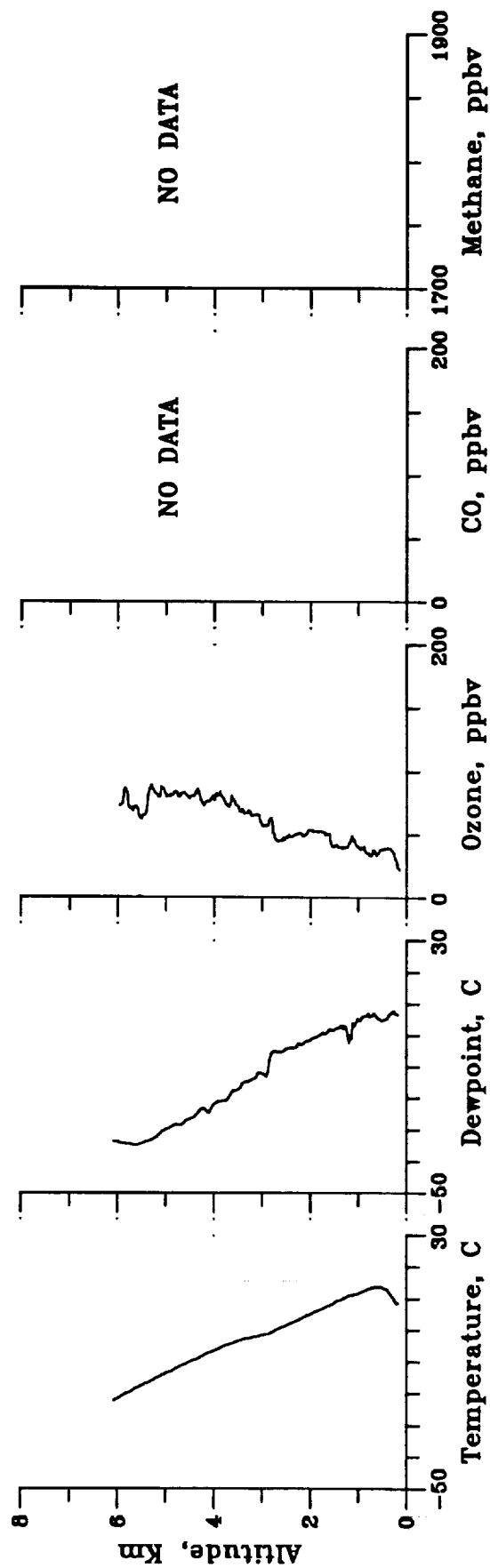


Figure A6.4

# ABLE-3A ALASKAN MISSION: FLIGHT 7.

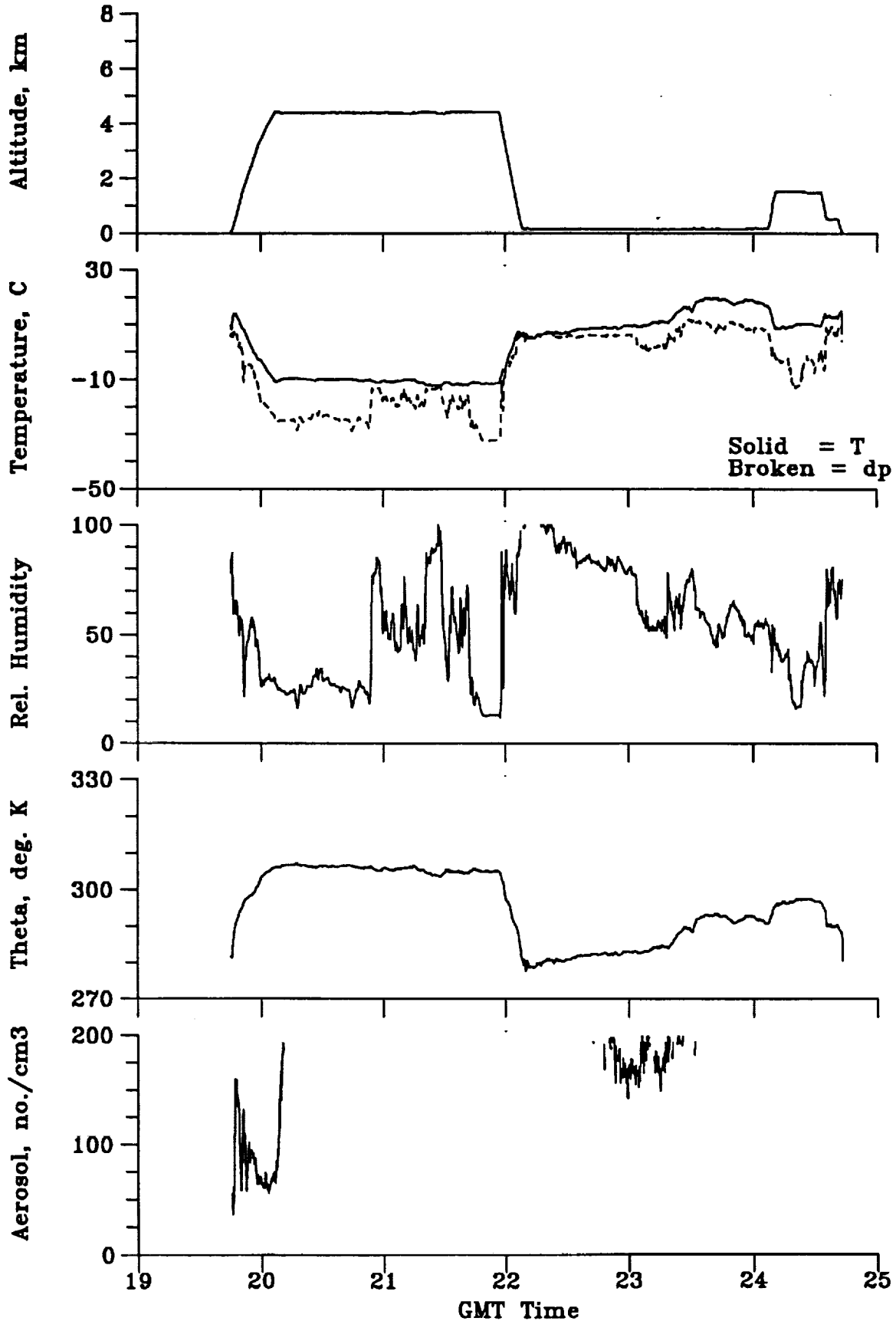


Figure A7.1

# ABLE-3A ALASKAN MISSION: FLIGHT 7.

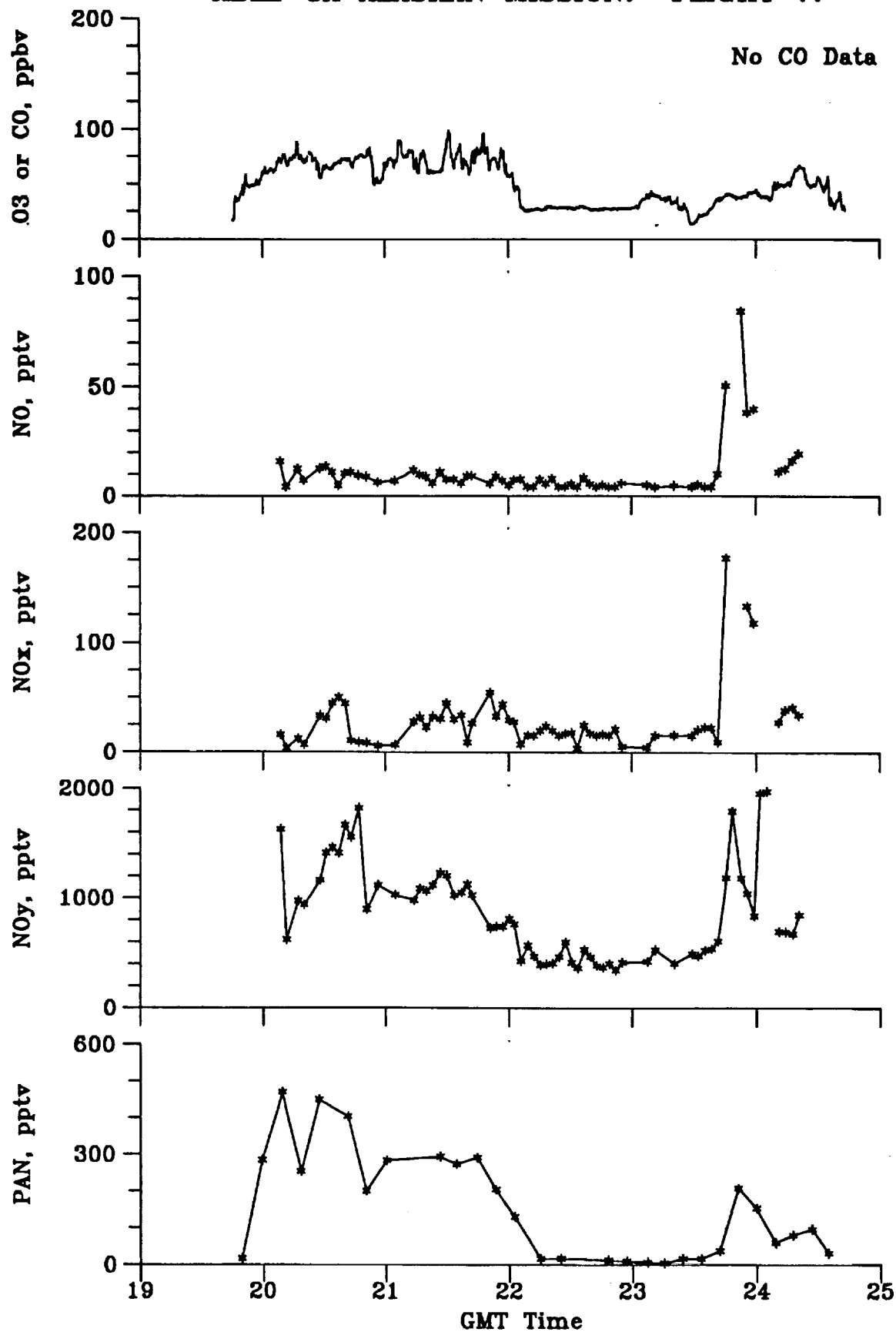


Figure A7.2

# ABLE-3A ALASKAN MISSION: FLIGHT 7.

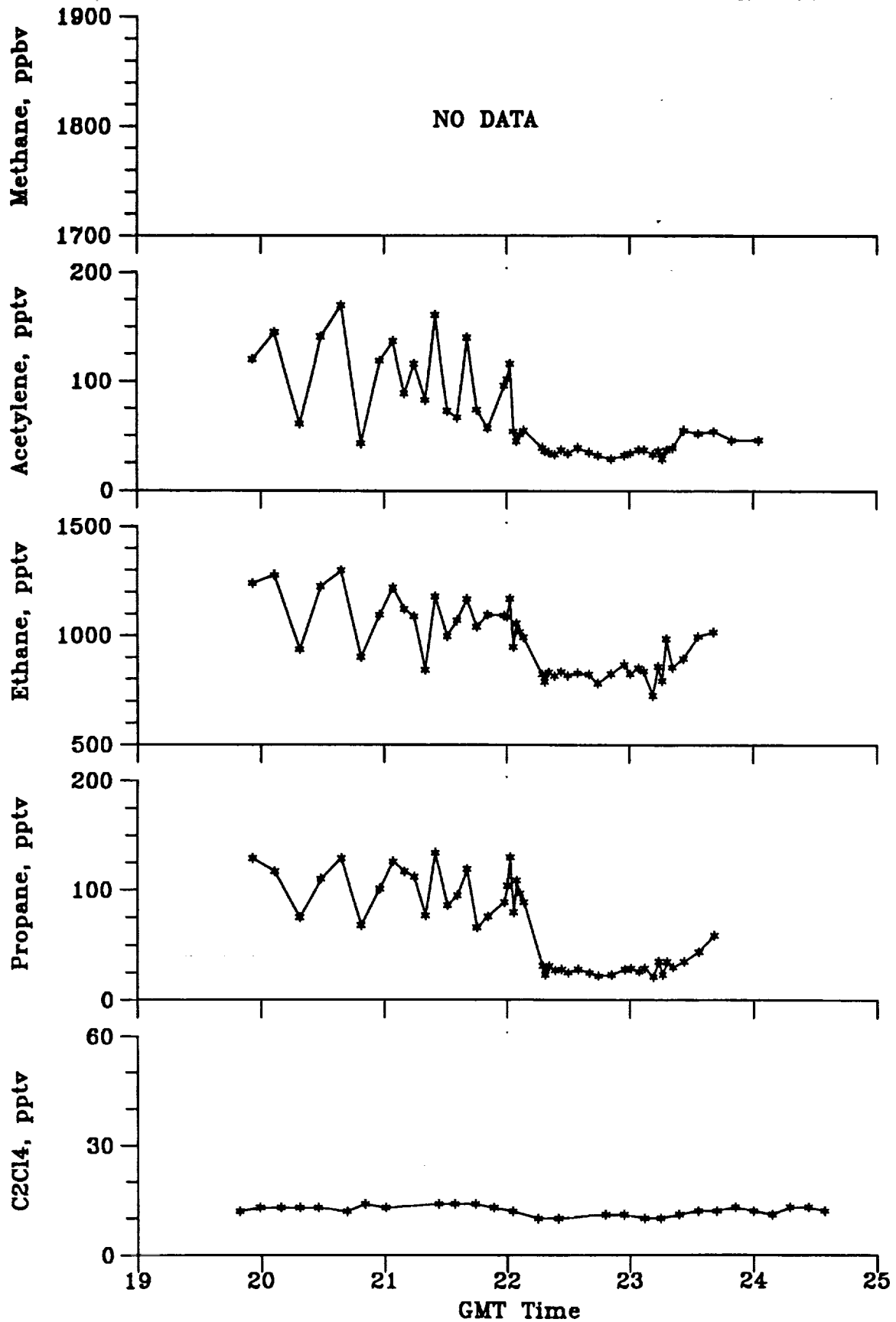


Figure A7.3

ABLE-3A ALASKAN MISSION: FLIGHT 7 PROFILE AT 2200 GMT

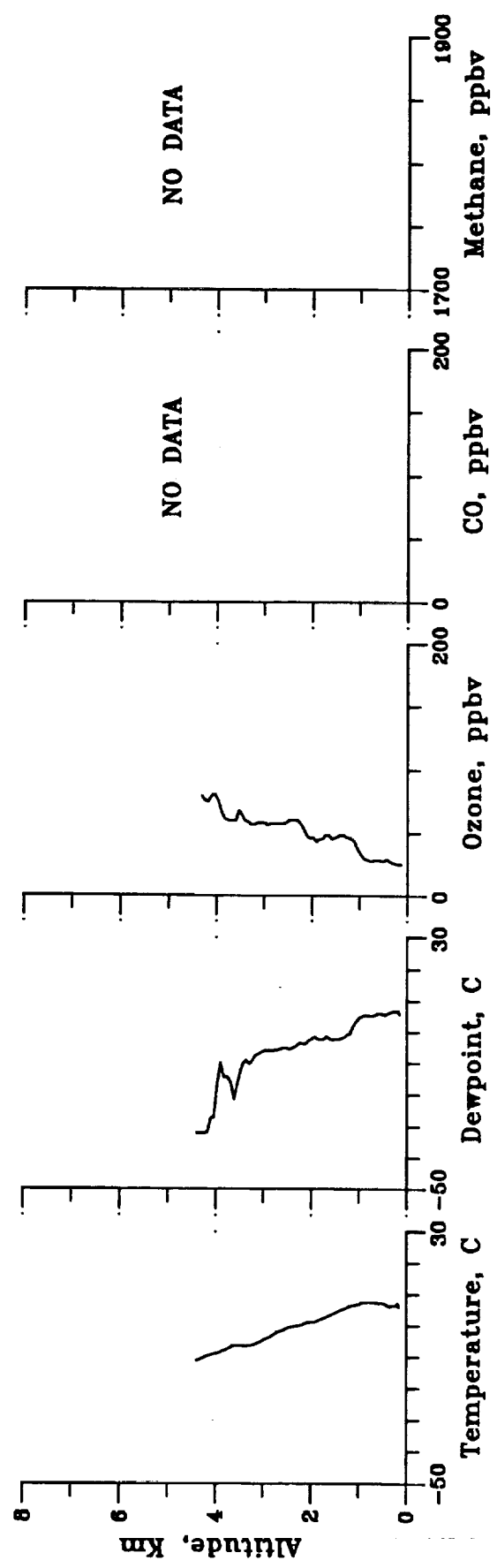


Figure A7.4

# ABLE-3A ALASKAN MISSION: FLIGHT 8.

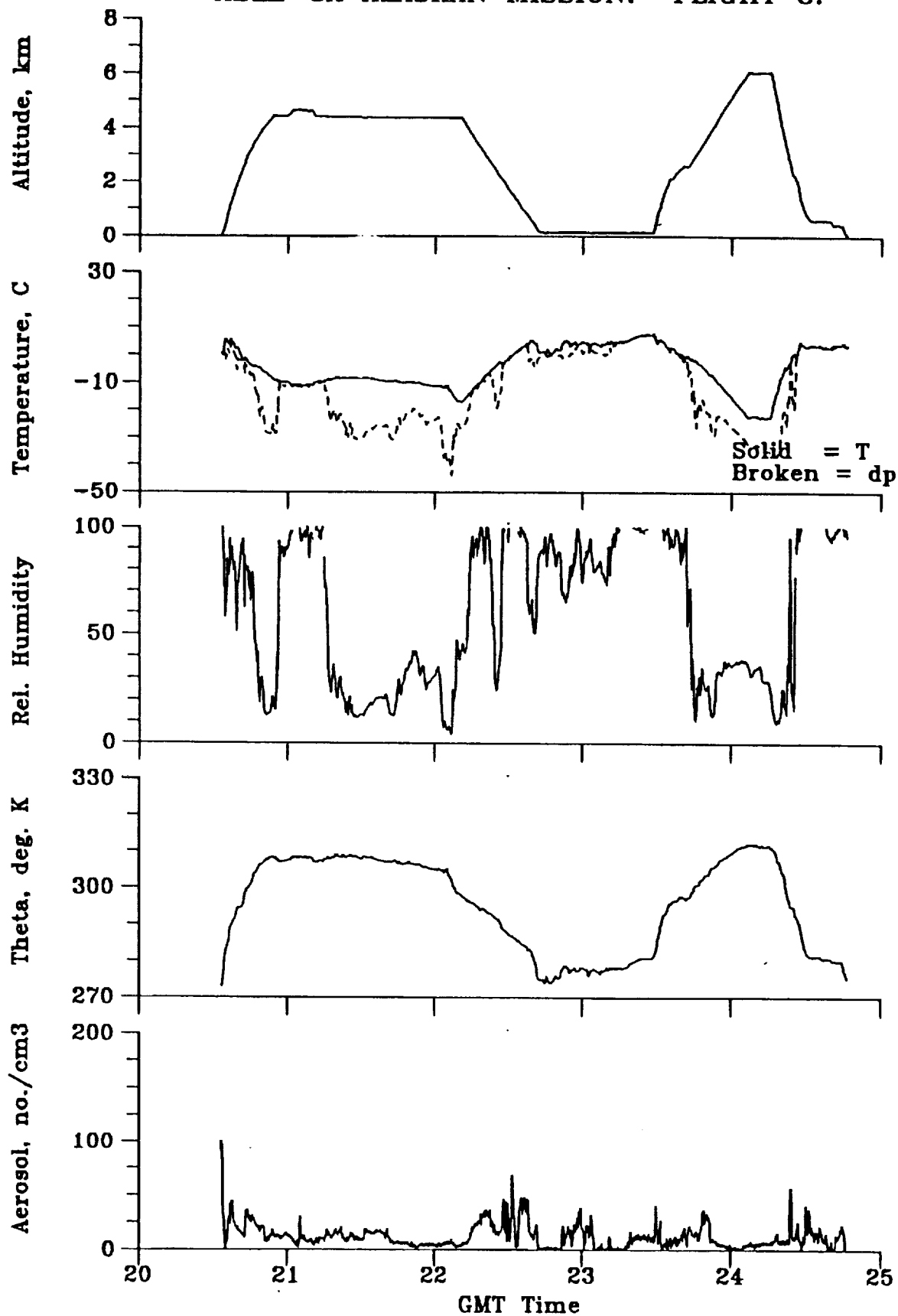


Figure A8.1



ABLE-3A ALASKAN MISSION: FLIGHT 8.

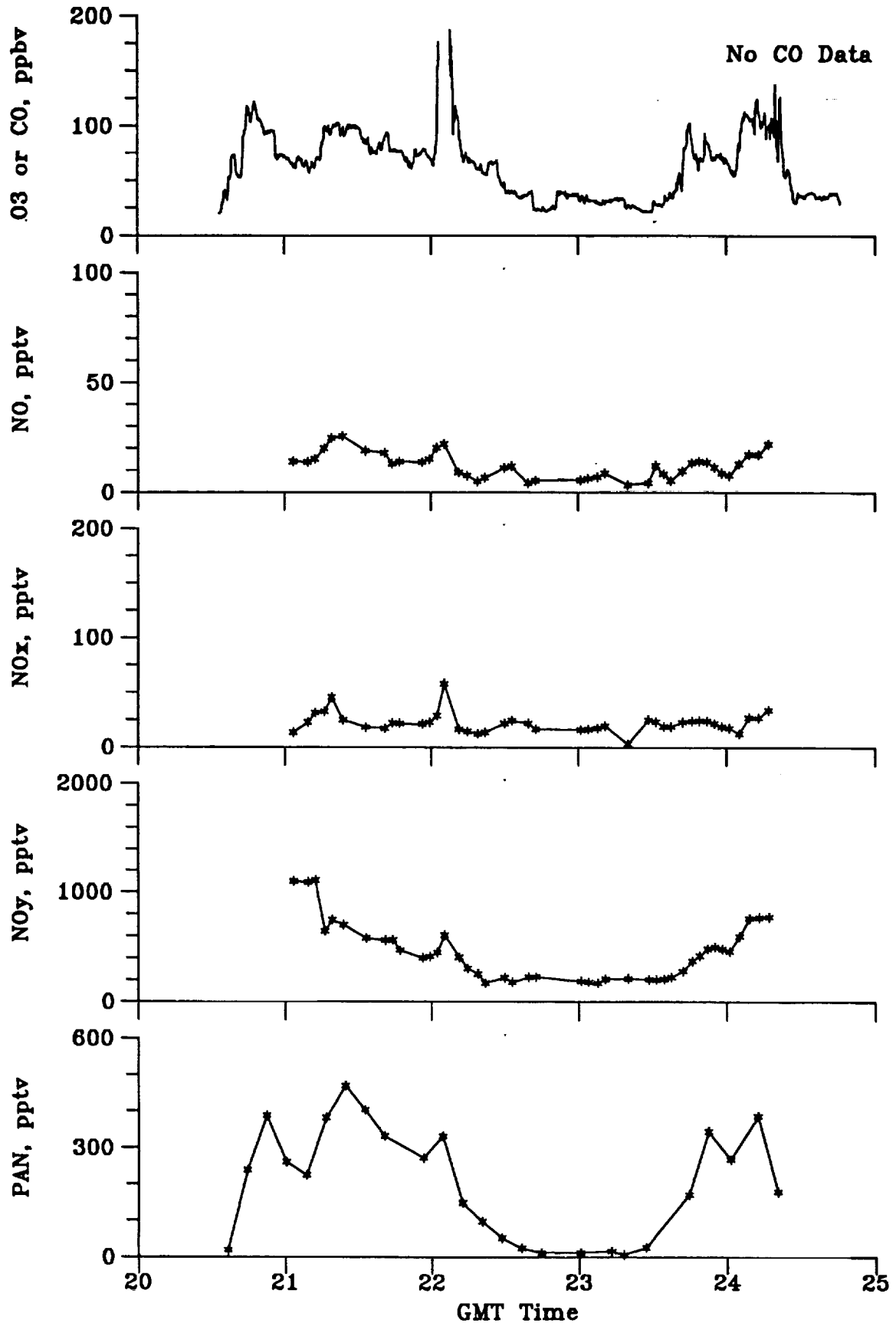


Figure A8.2

# ABLE-3A ALASKAN MISSION: FLIGHT 8.

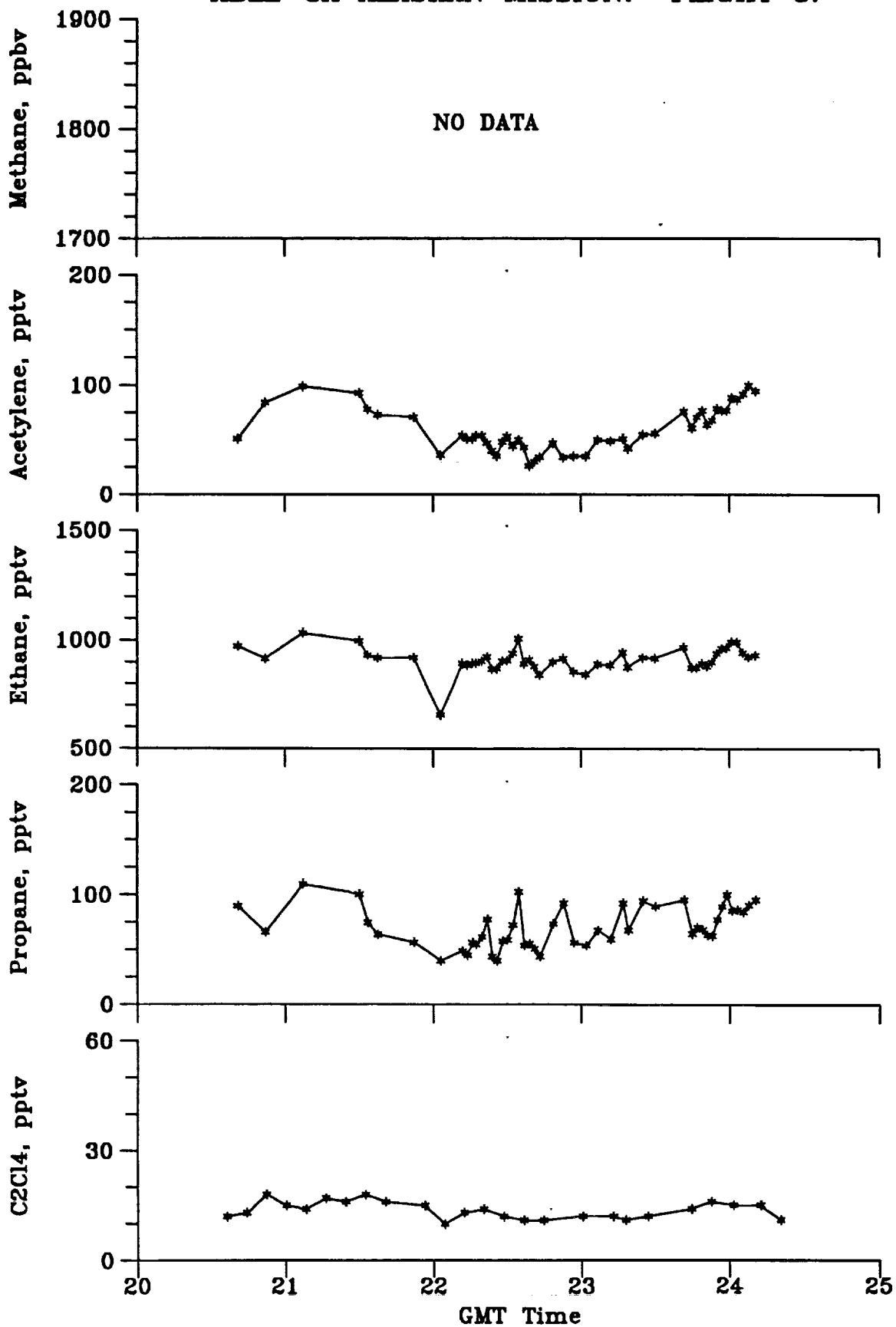


Figure A8.3

ABLE-3A ALASKAN MISSION: FLIGHT 8 PROFILE AT 2230 GMT

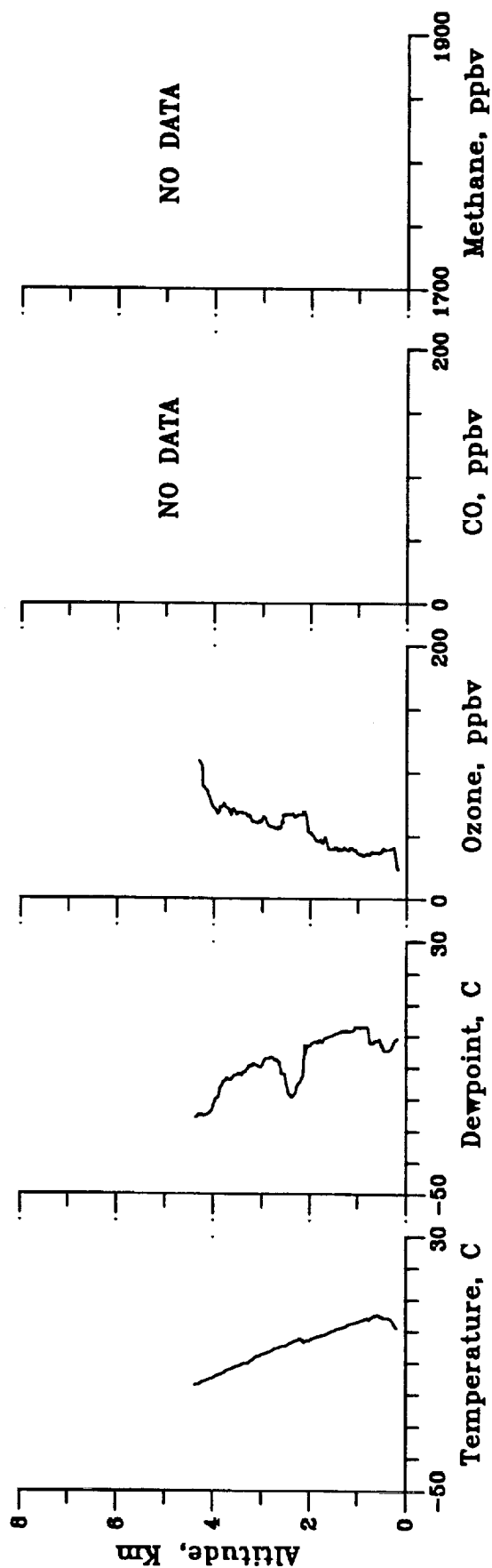


Figure A8.4

# ABLE-3A ALASKAN MISSION: FLIGHT 9.

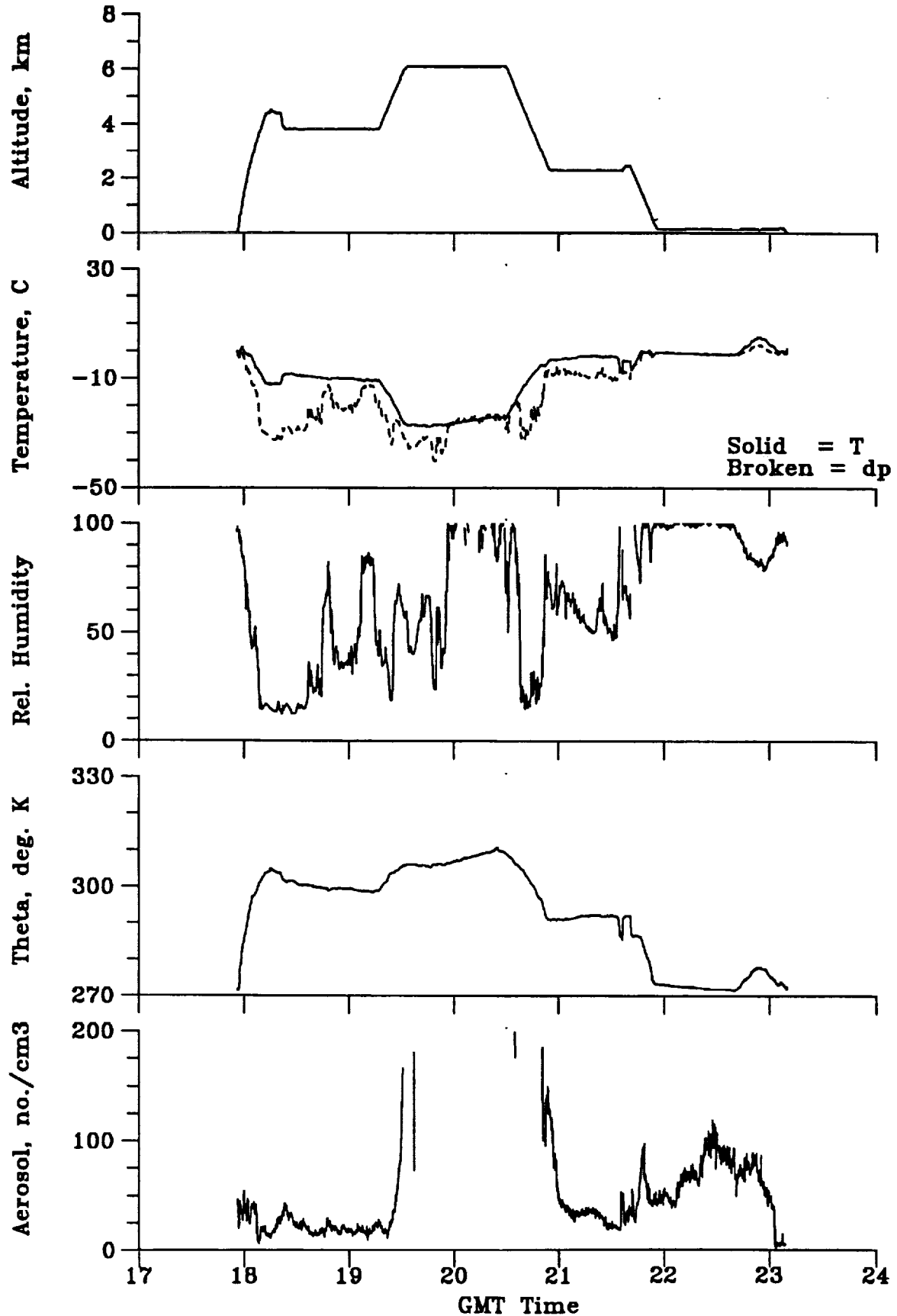


Figure A9.1

# ABLE-3A ALASKAN MISSION: FLIGHT 9.

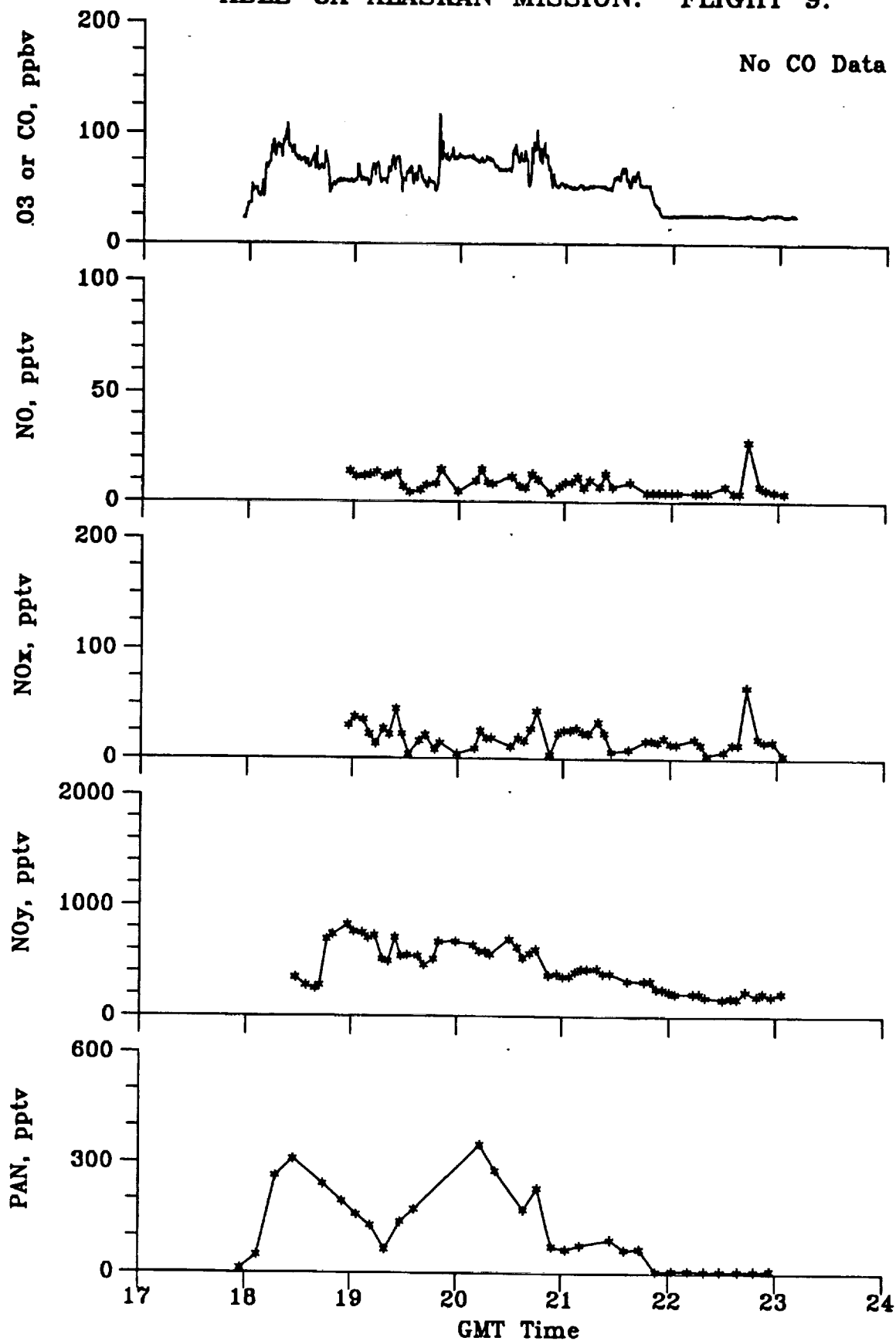


Figure A9.2

# ABLE-3A ALASKAN MISSION: FLIGHT 9.

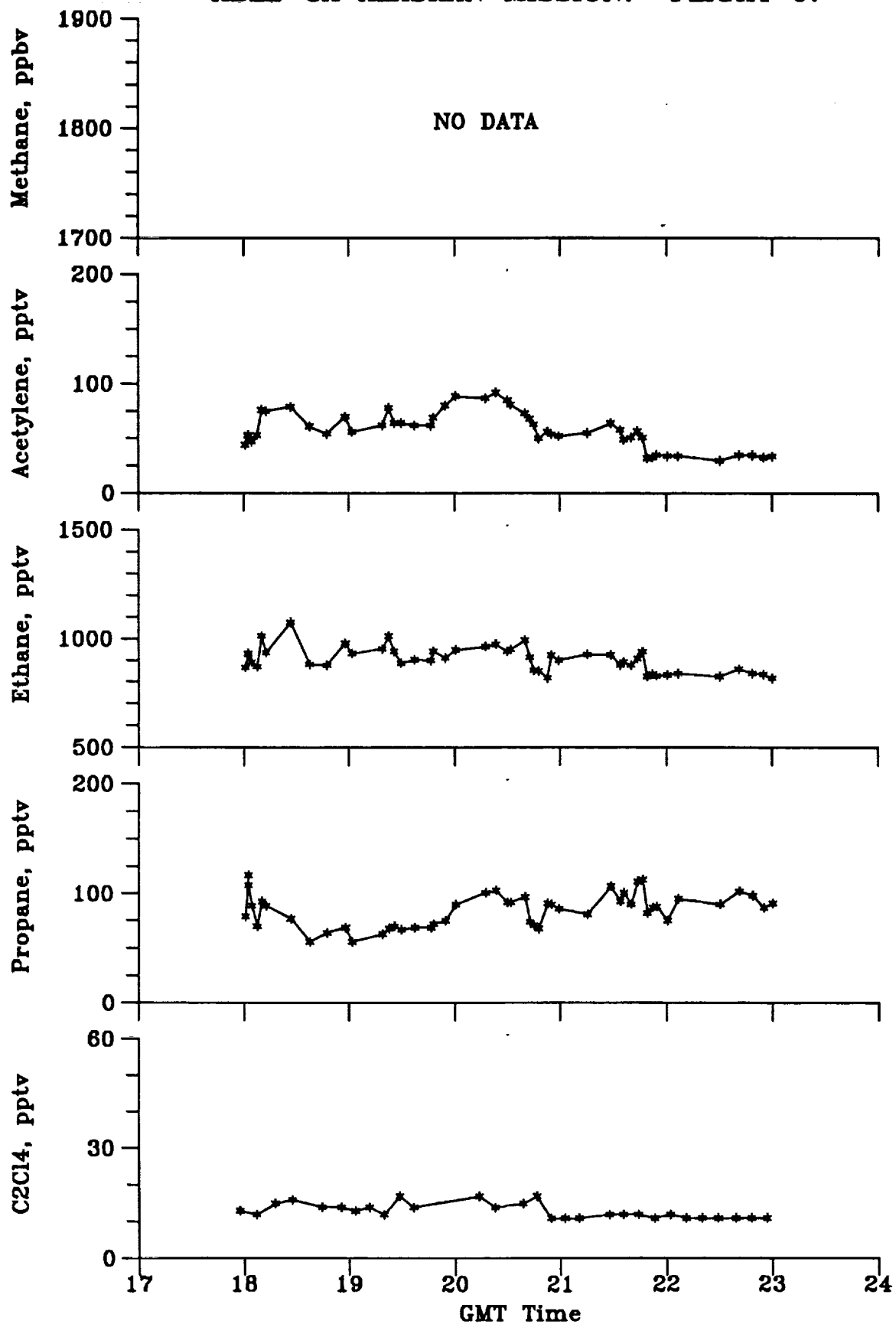


Figure A9.3

ABLE-3A ALASKAN MISSION: FLIGHT 9 PROFILE AT 1800 GMT

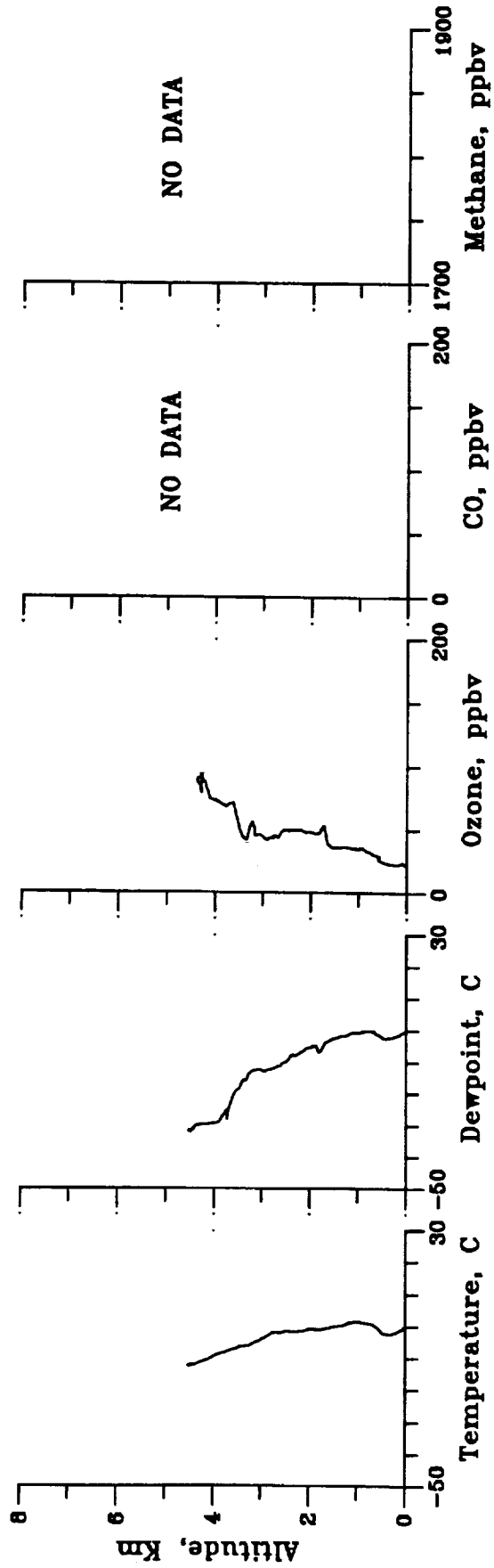


Figure A9.4

# ABLE-3A ALASKAN MISSION: FLIGHT 10.

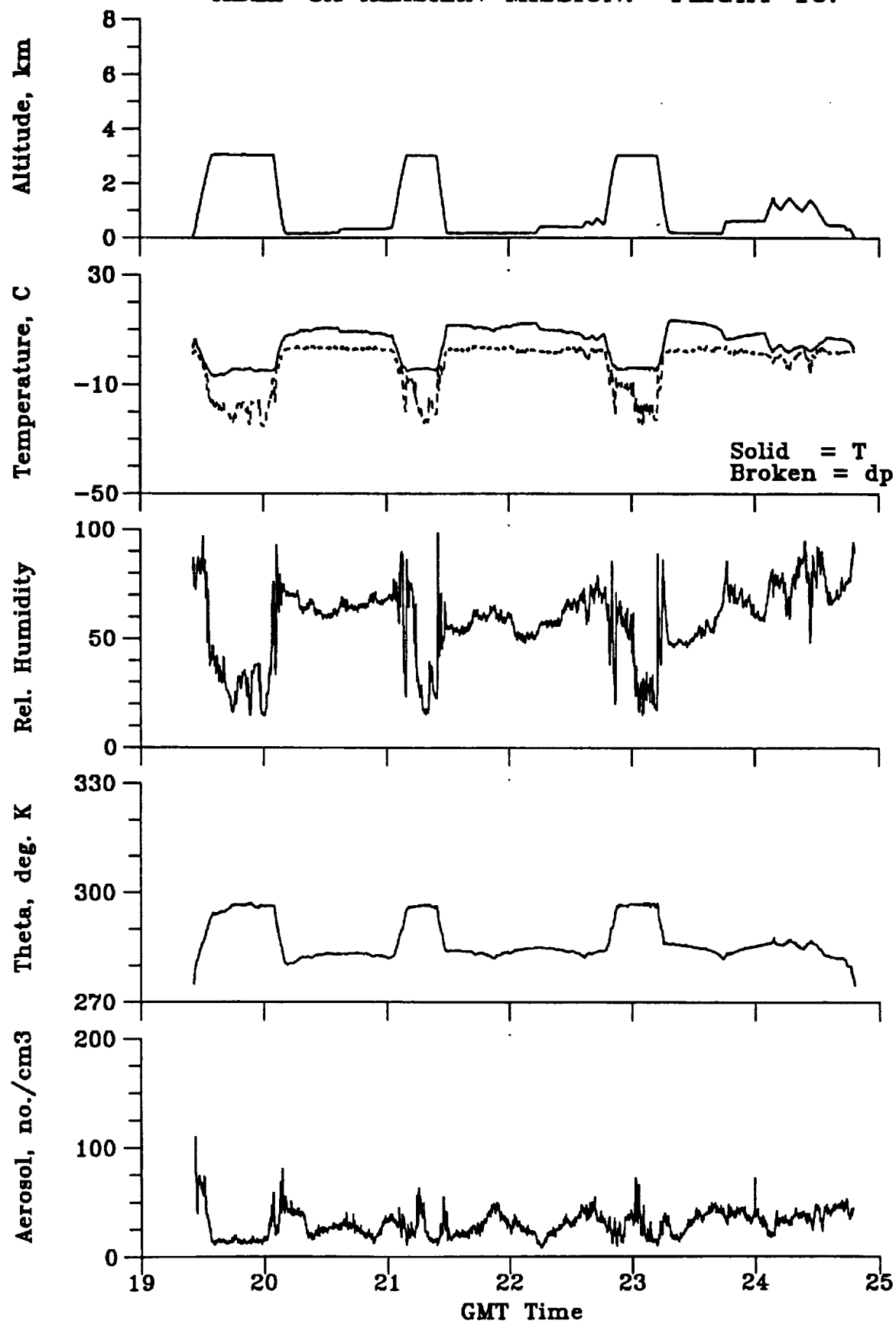


Figure A10.1



ABLE-3A ALASKAN MISSION: FLIGHT 10.

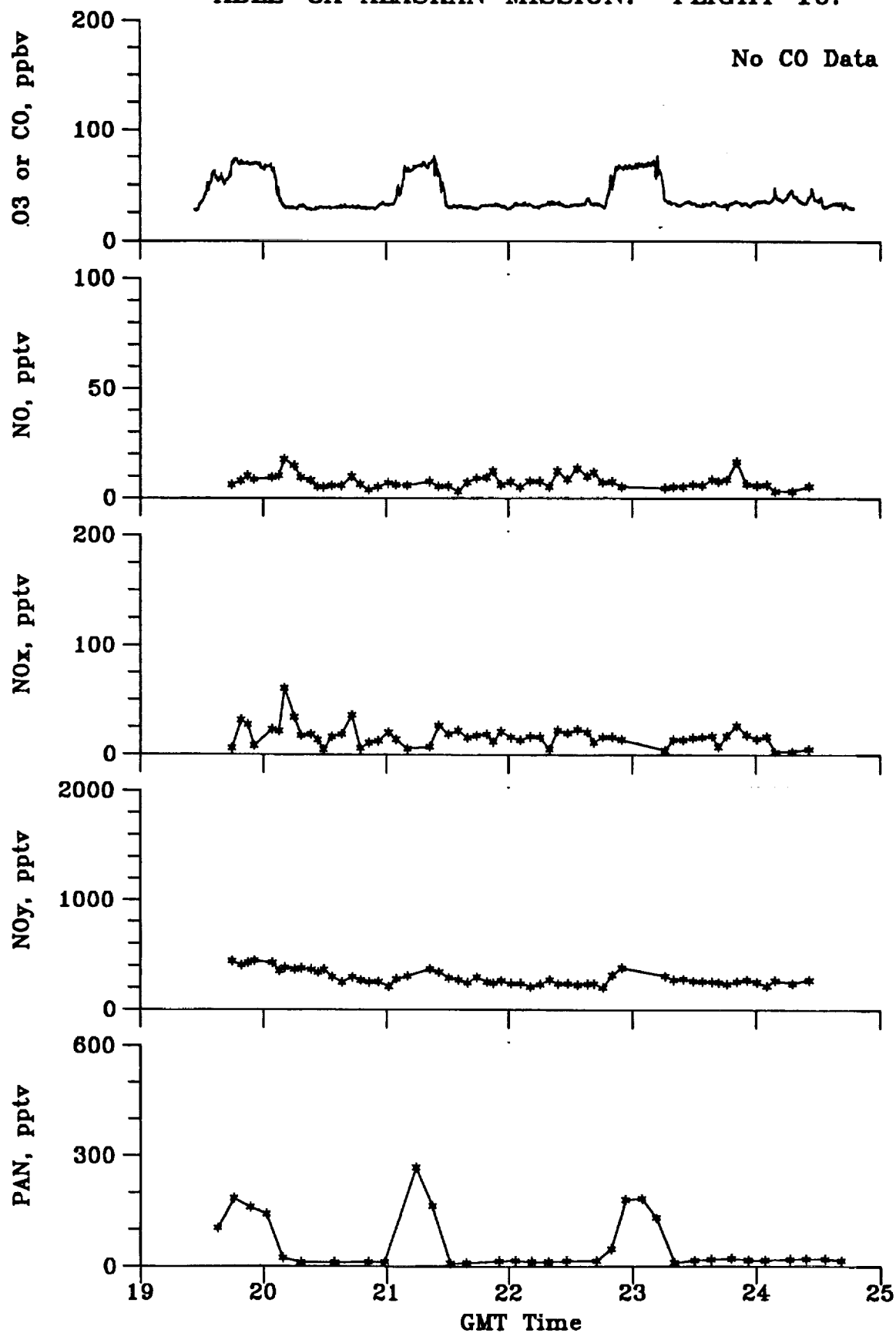


Figure A10.2

ABLE-3A ALASKAN MISSION: FLIGHT 10.

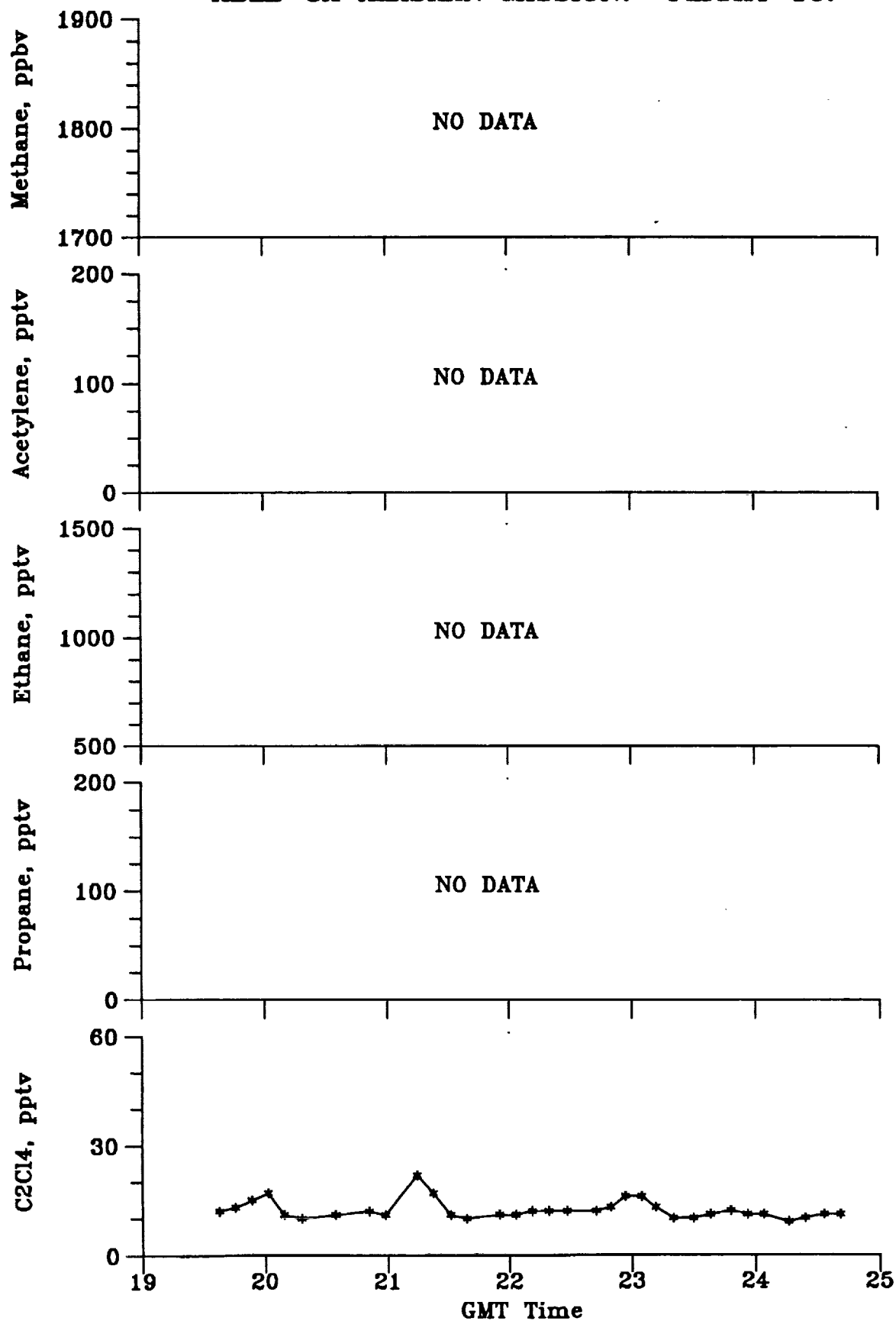
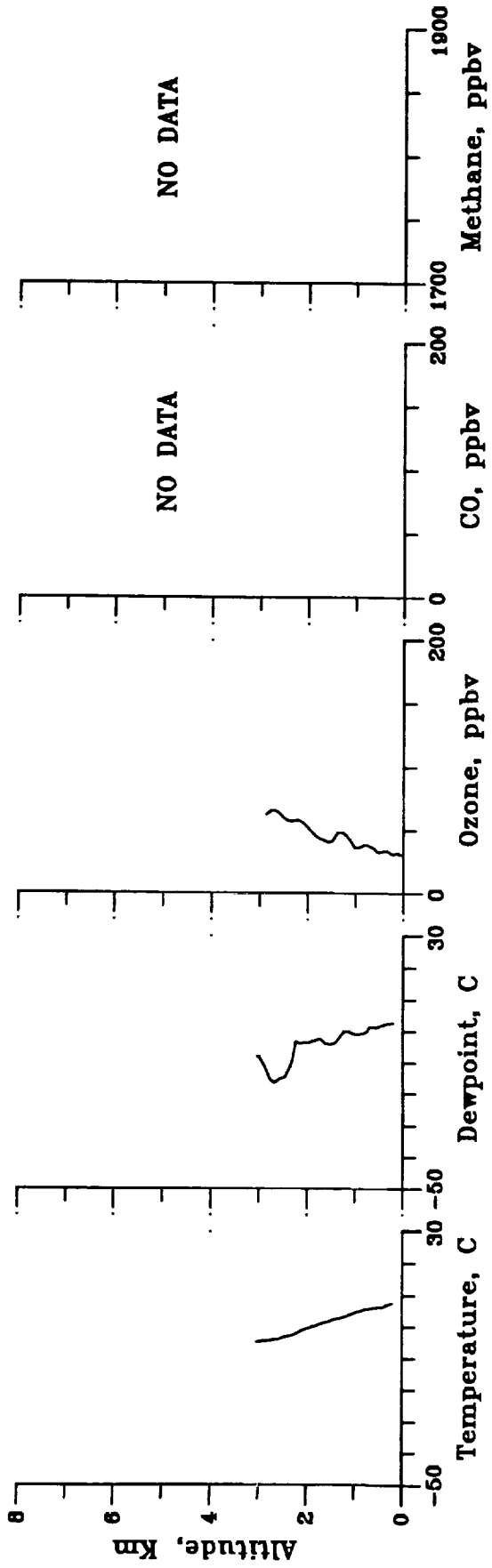


Figure A10.3

ABLE-3A ALASKAN MISSION: FLIGHT 10 PROFILE AT 2010 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 10 PROFILE AT 2315 GMT

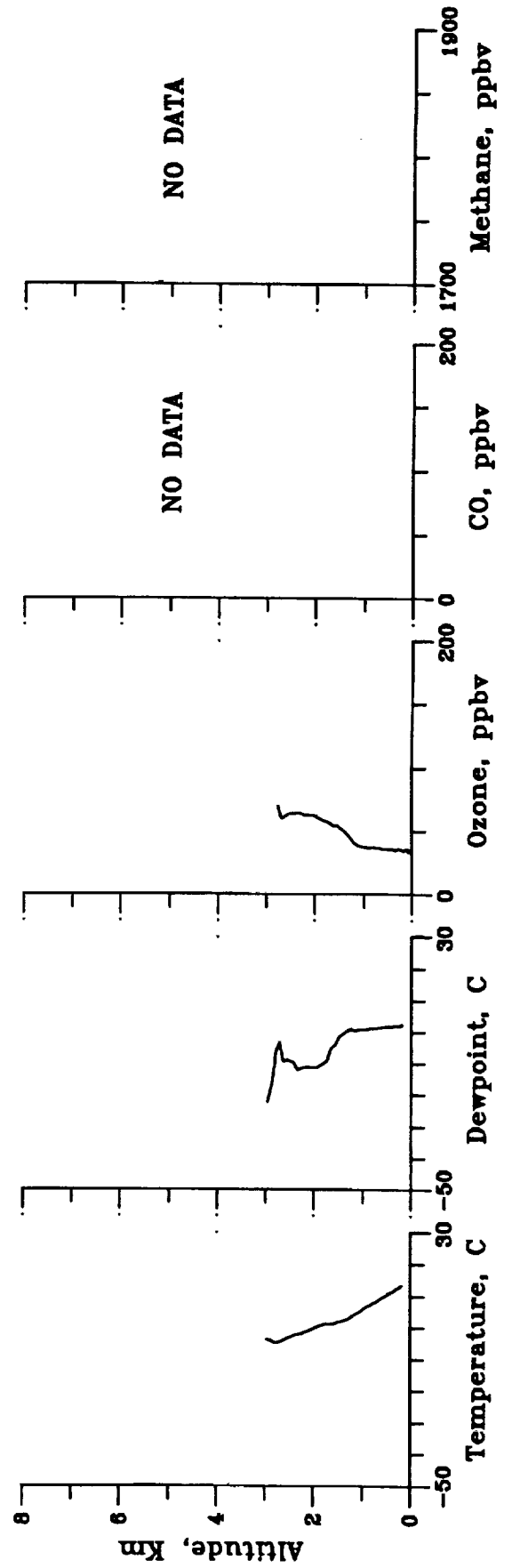


Figure A10.4

# ABLE-3A ALASKAN MISSION: FLIGHT 11.

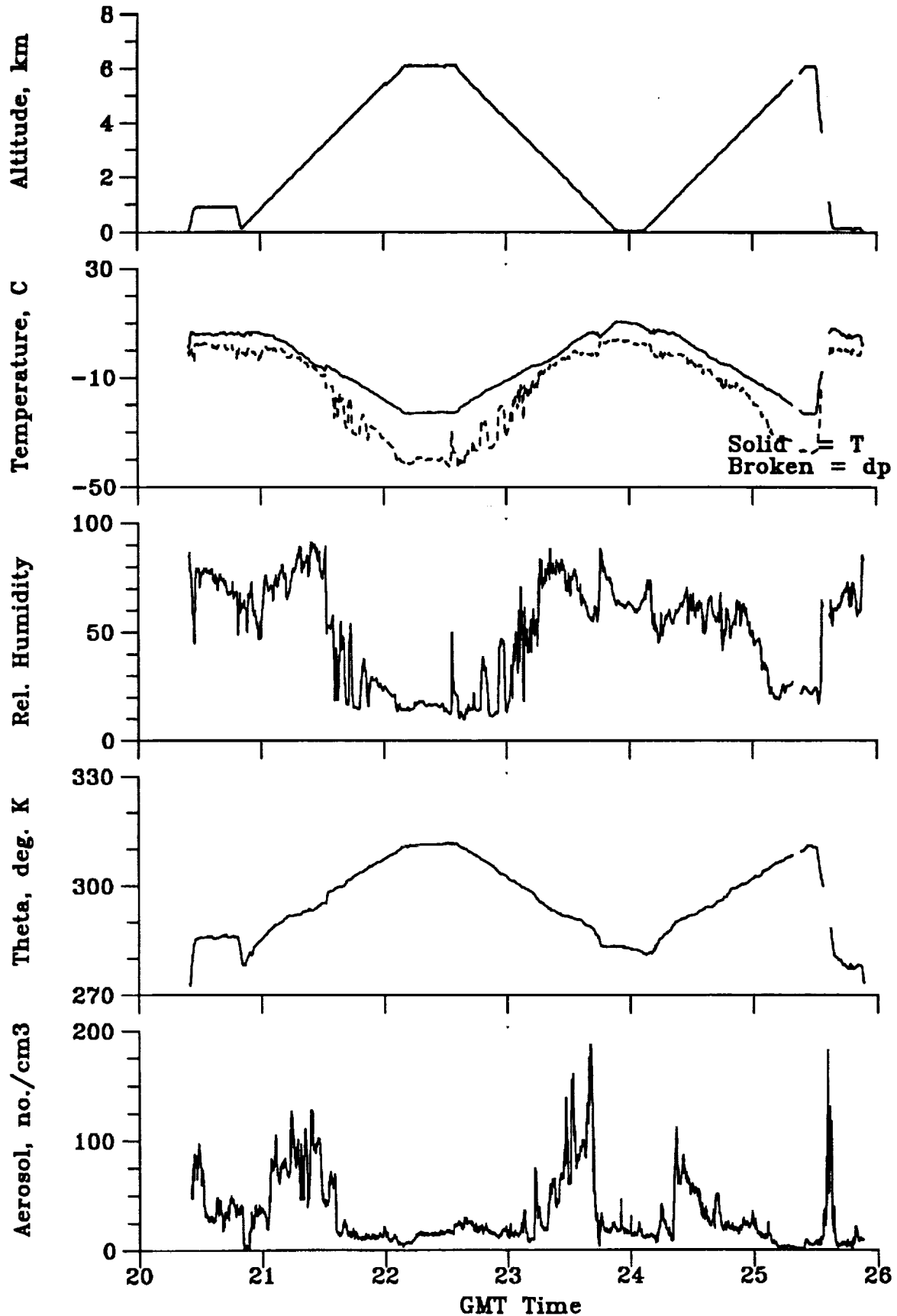


Figure A11.1

ABLE-3A ALASKAN MISSION: FLIGHT 11.

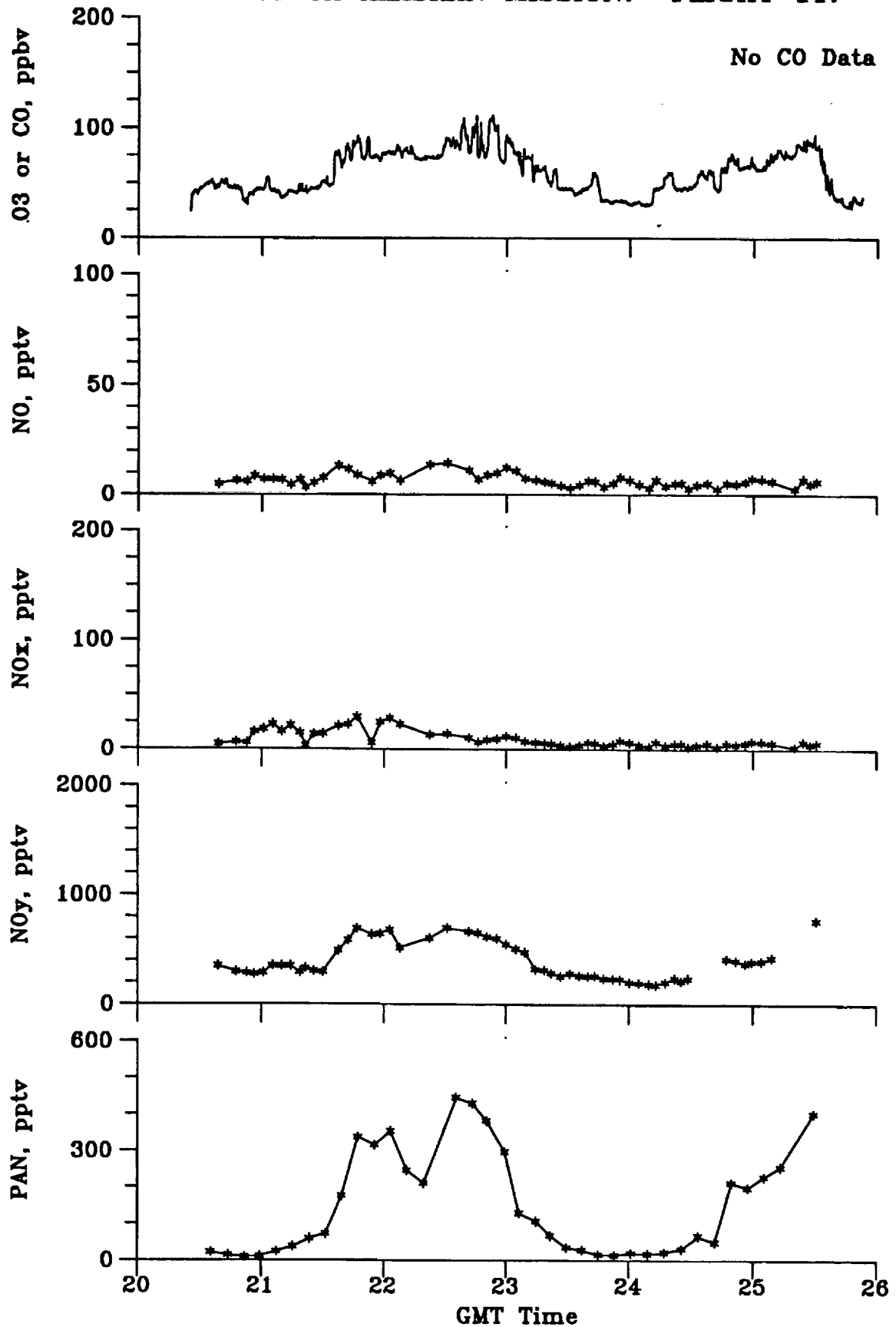


Figure A11.2

ABLE-3A ALASKAN MISSION: FLIGHT 11.

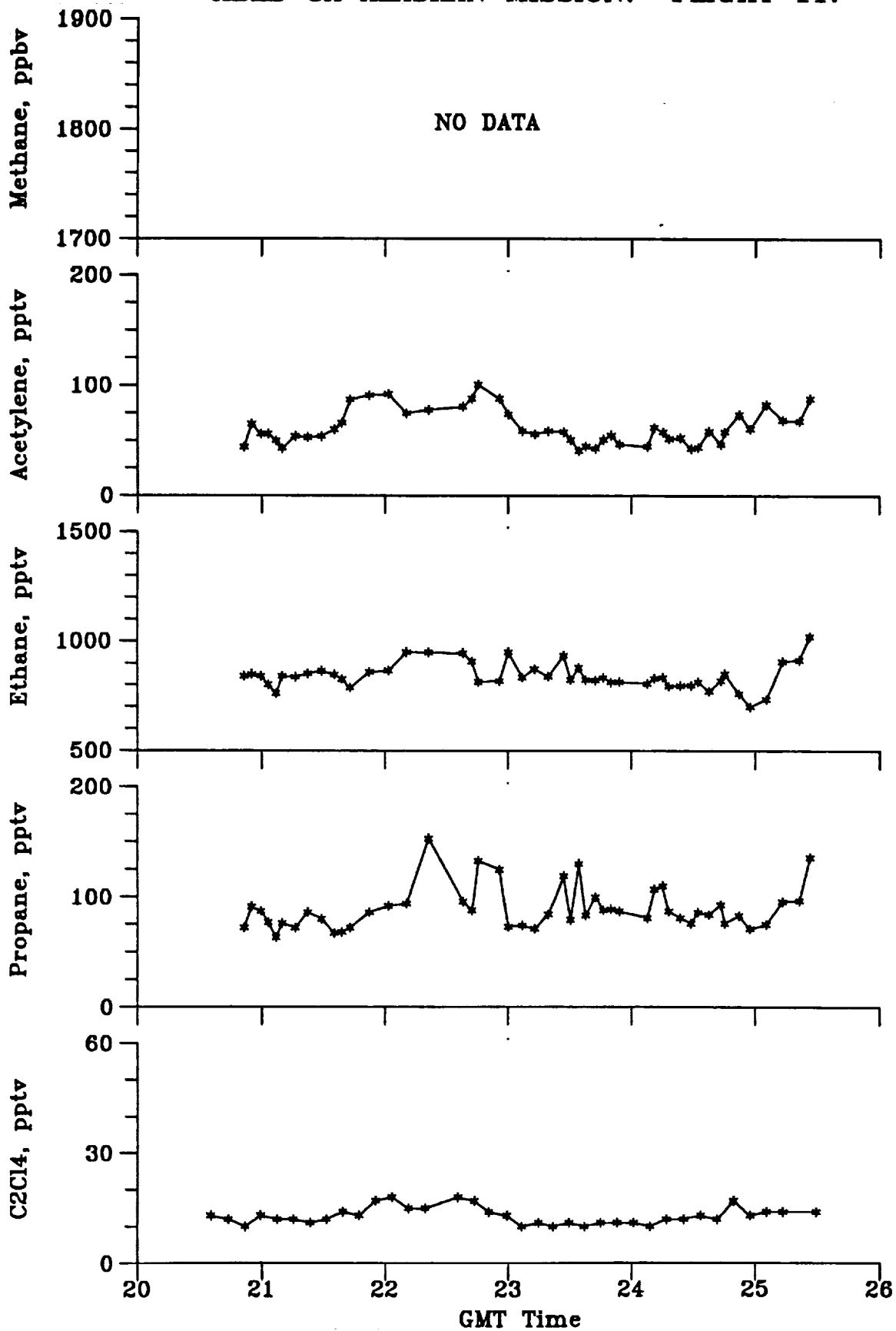
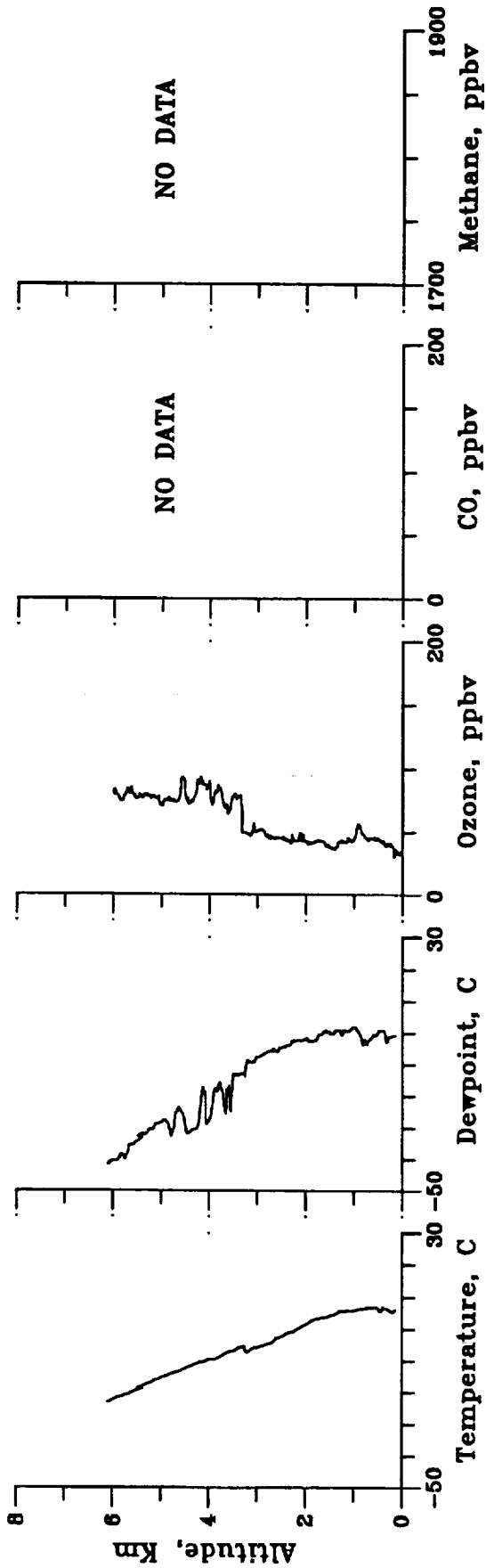


Figure A11.3

ABLE-3A ALASKAN MISSION: FLIGHT 11 PROFILE AT 2130 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 11 PROFILE AT 2245 GMT

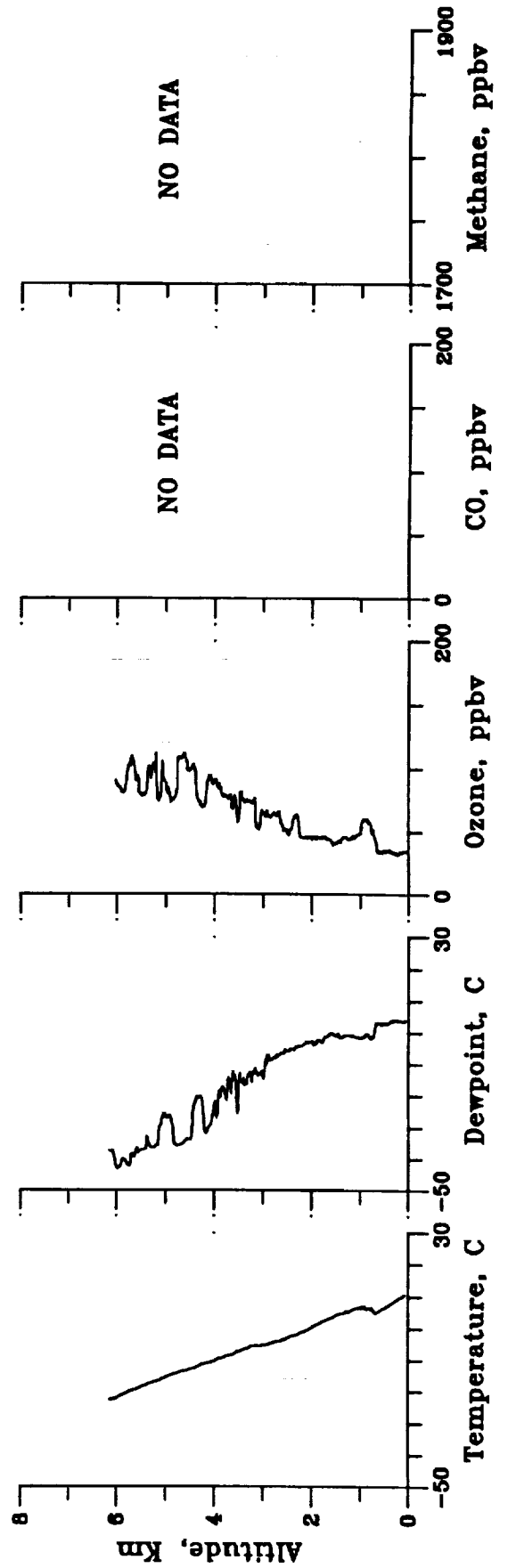


Figure A11.4

# ABLE-3A ALASKAN MISSION: FLIGHT 12.

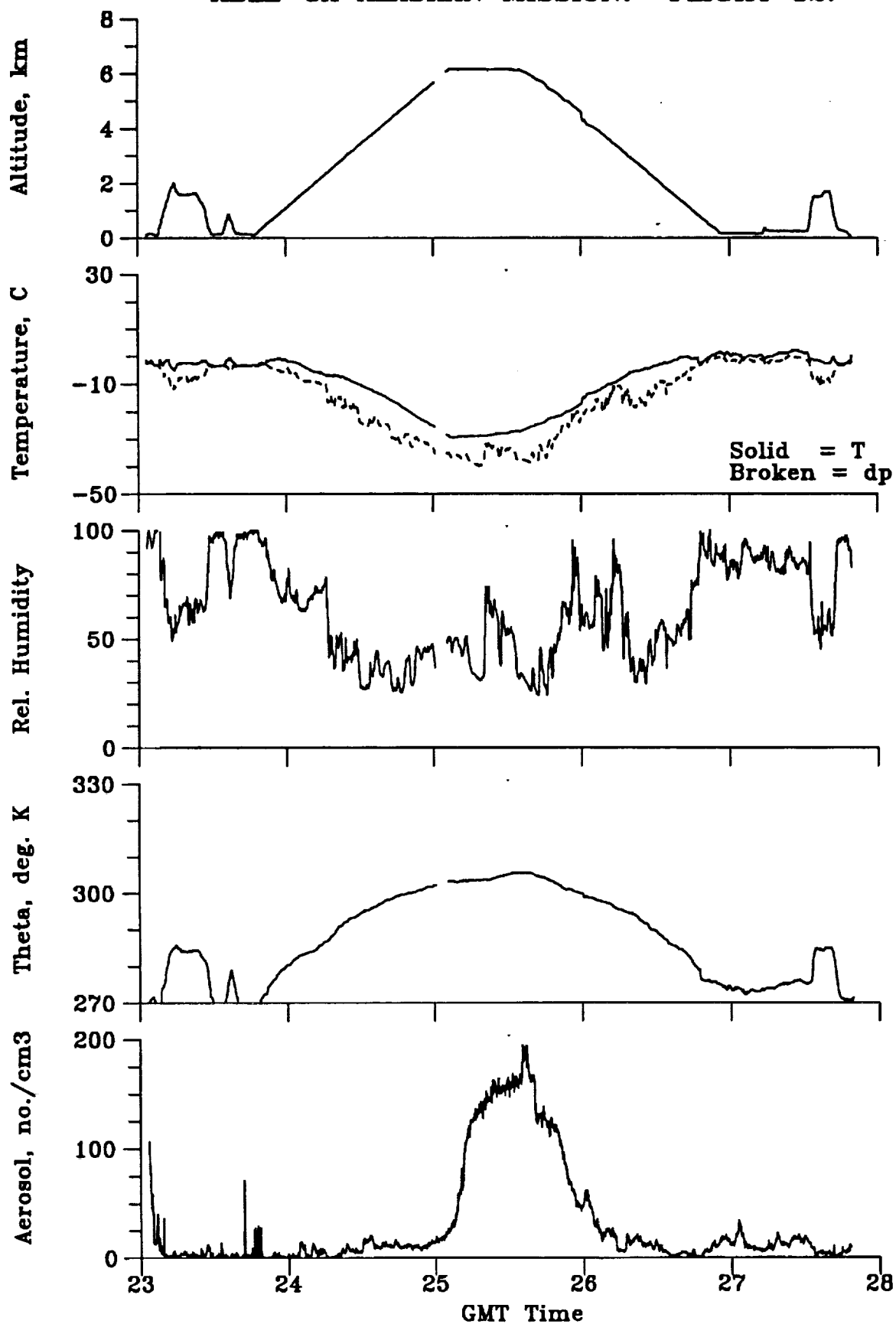


Figure A12.1



# ABLE-3A ALASKAN MISSION: FLIGHT 12.

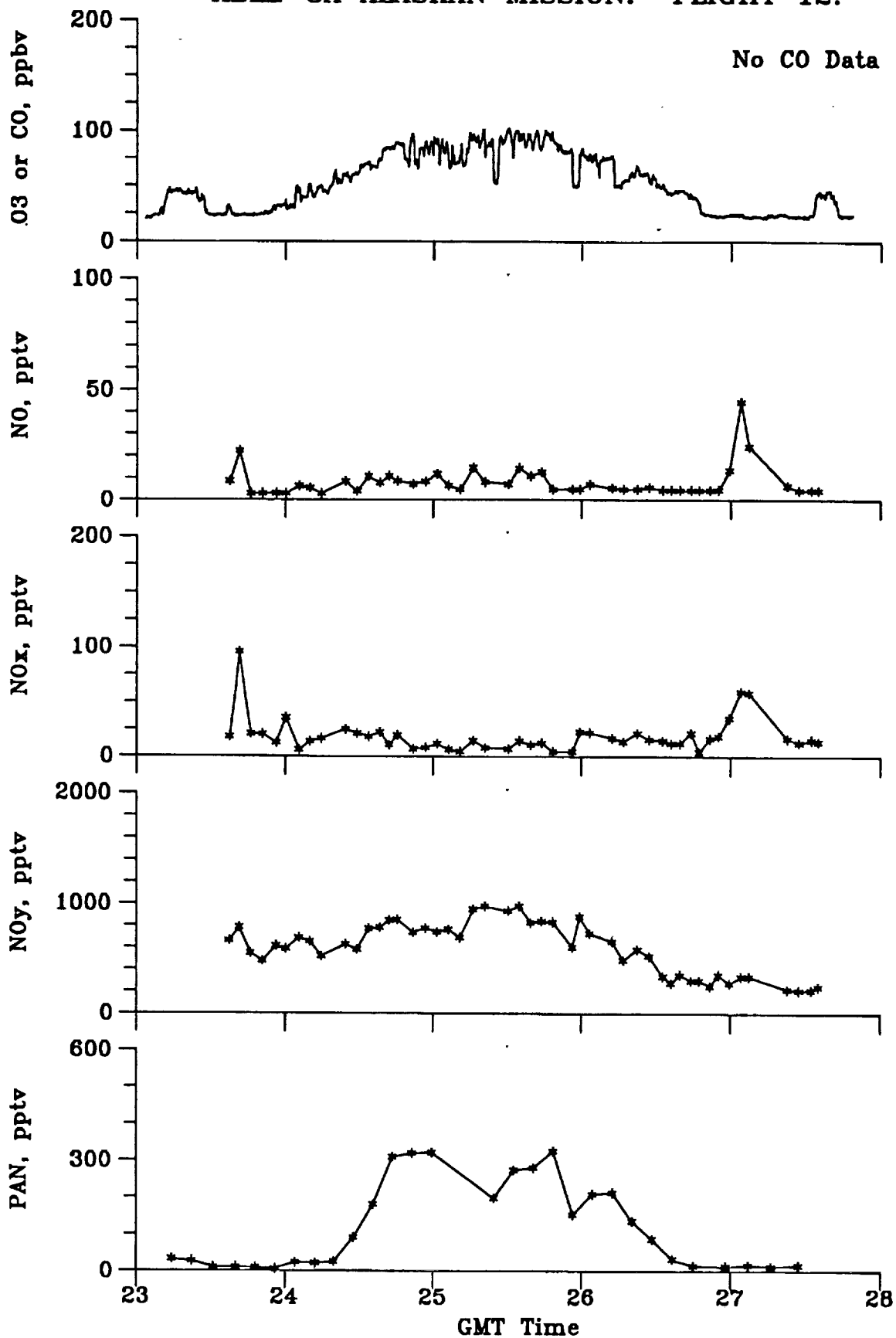


Figure A12.2

ABLE-3A ALASKAN MISSION: FLIGHT 12.

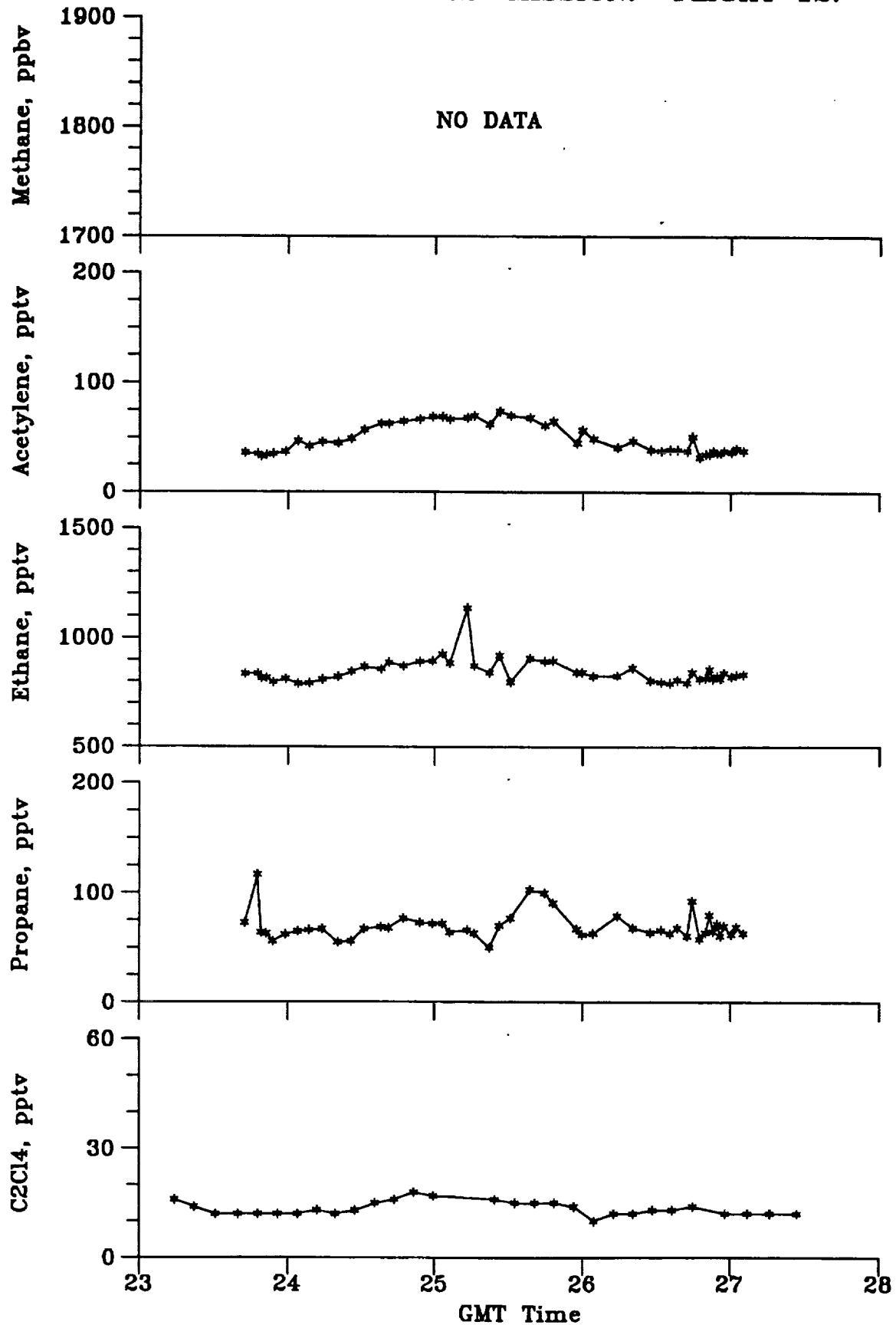
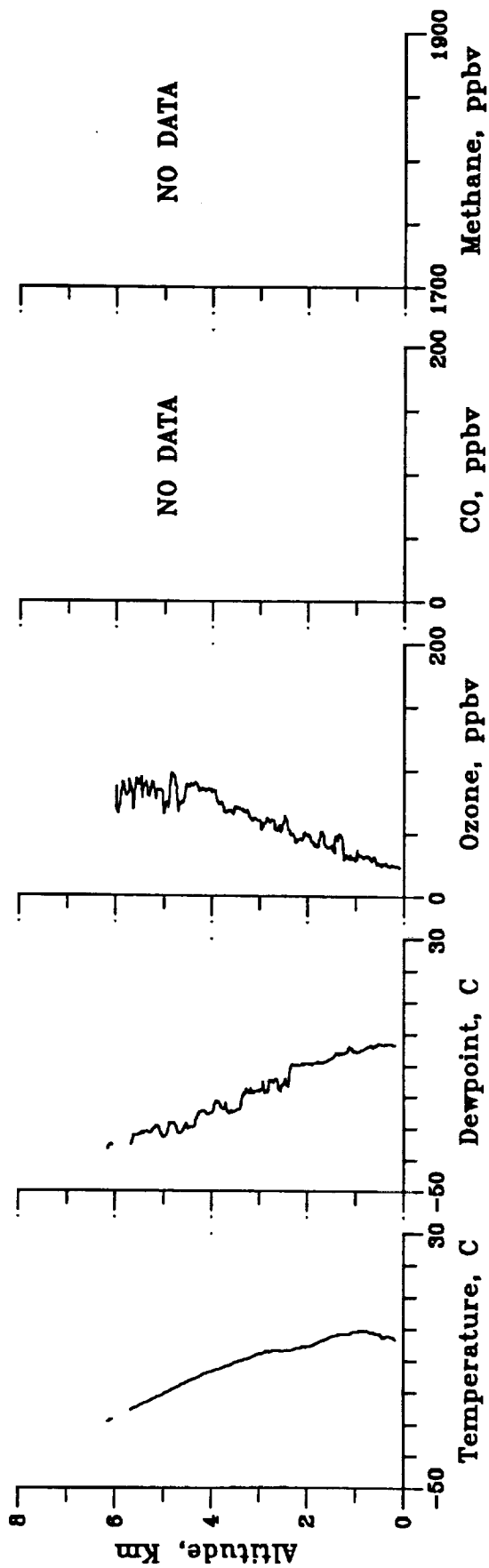


Figure A12.3

ABLE-3A ALASKAN MISSION: FLIGHT 12 PROFILE AT 0000 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 12 PROFILE AT 0215 GMT

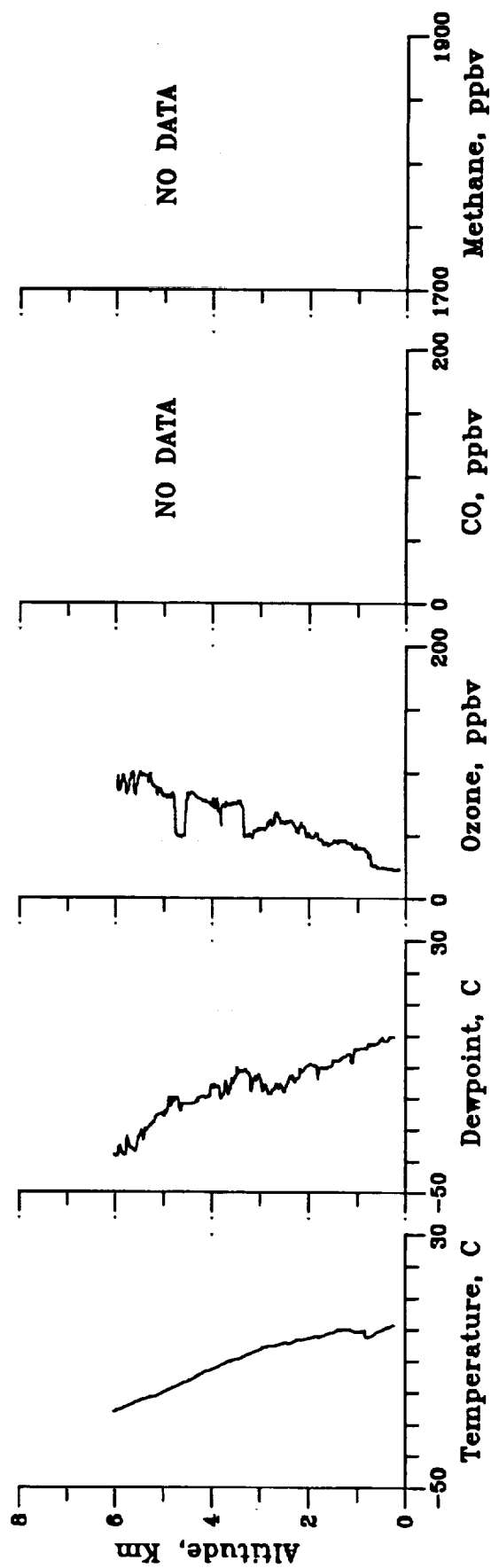


Figure A12.4

ABLE-3A ALASKAN MISSION: FLIGHT 13.

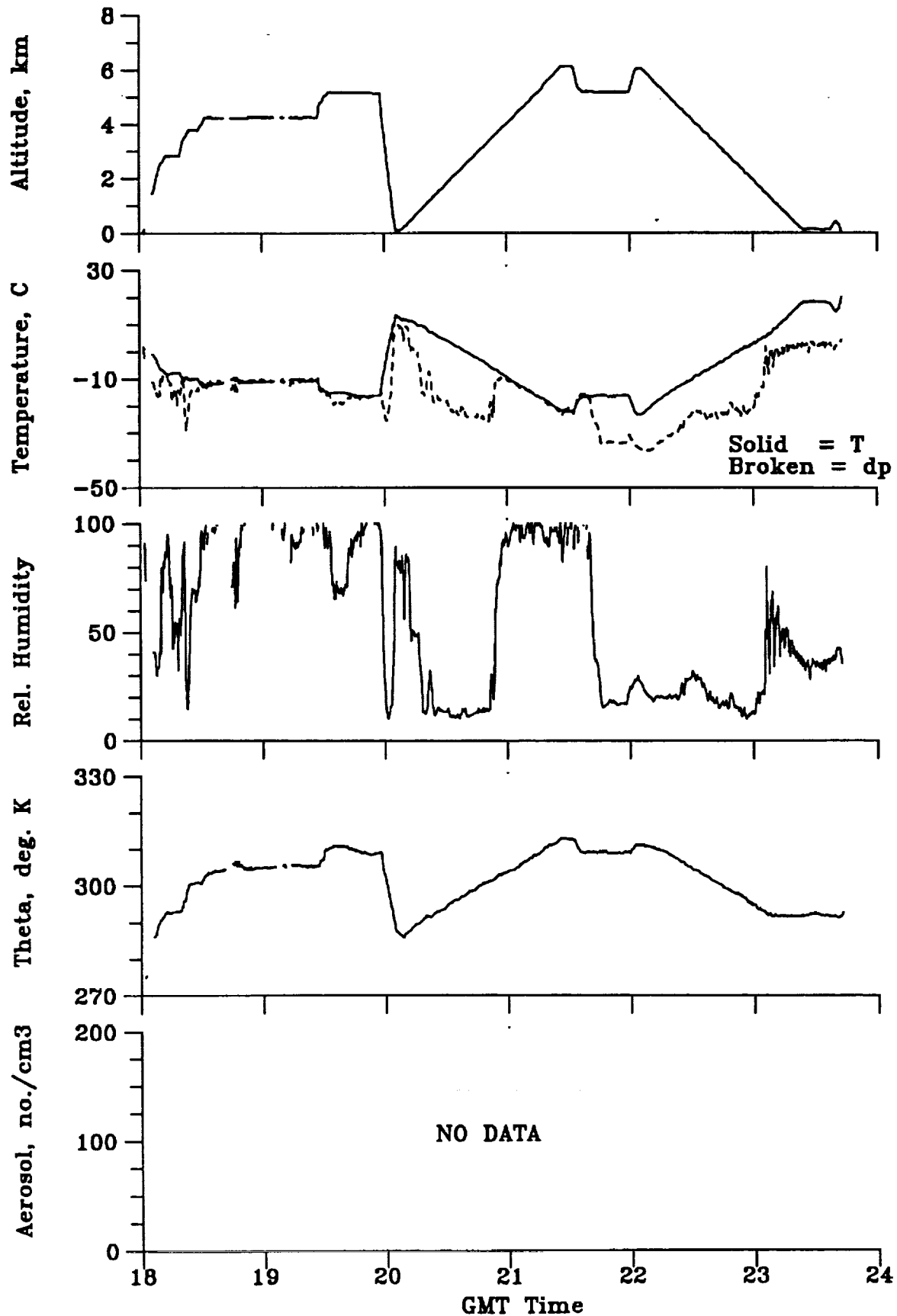


Figure A13.1

# ABLE-3A ALASKAN MISSION: FLIGHT 13.

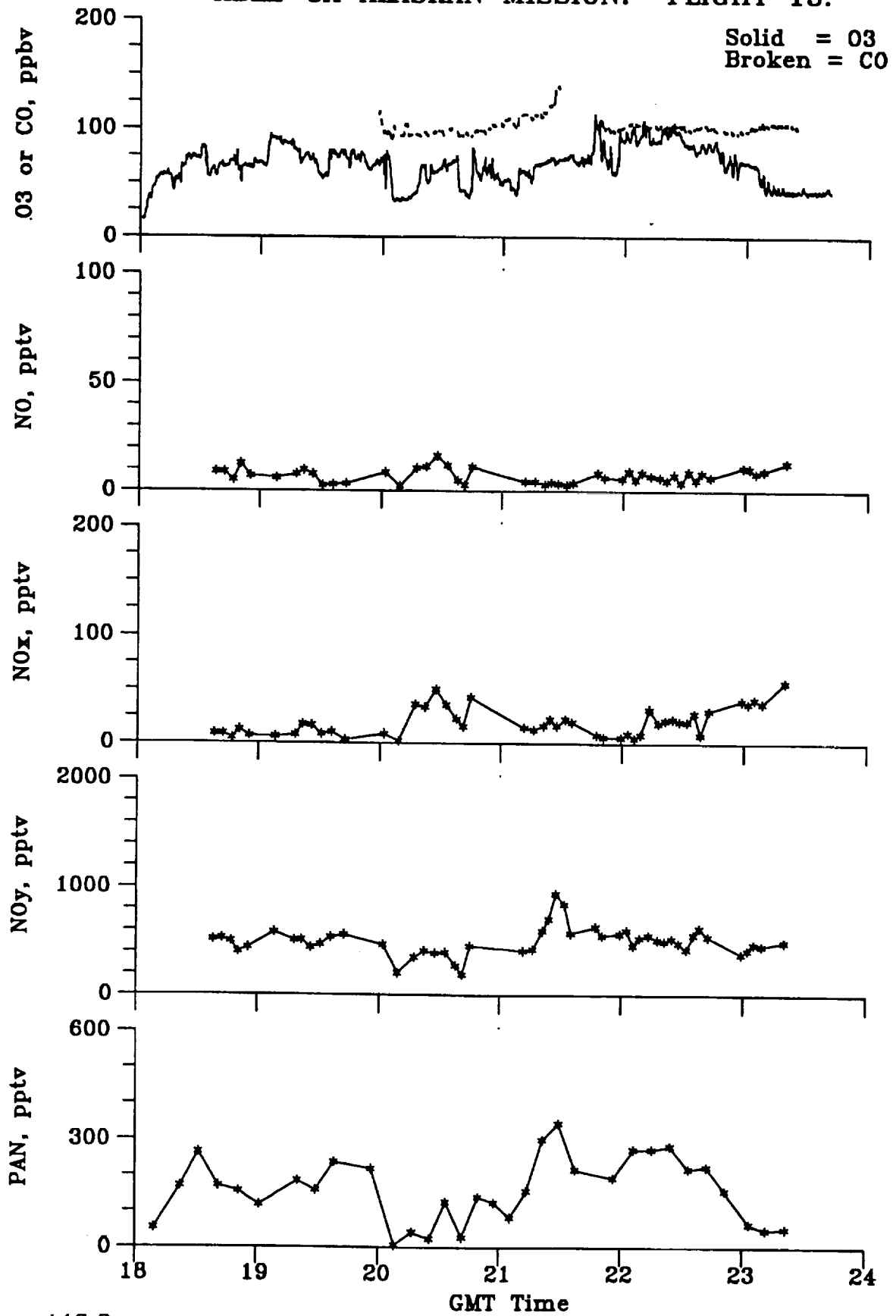


Figure A13.2

# ABLE-3A ALASKAN MISSION: FLIGHT 13.

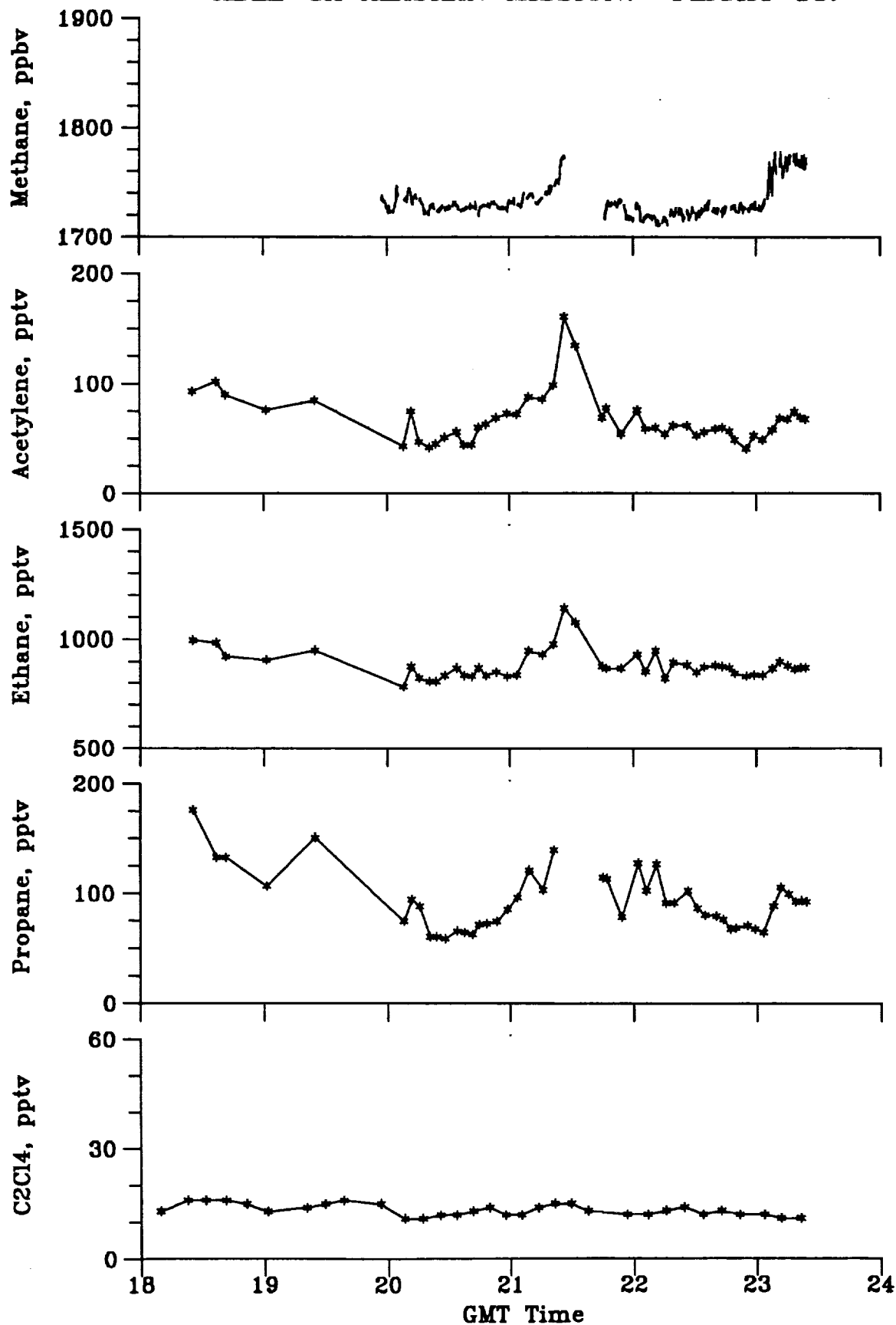
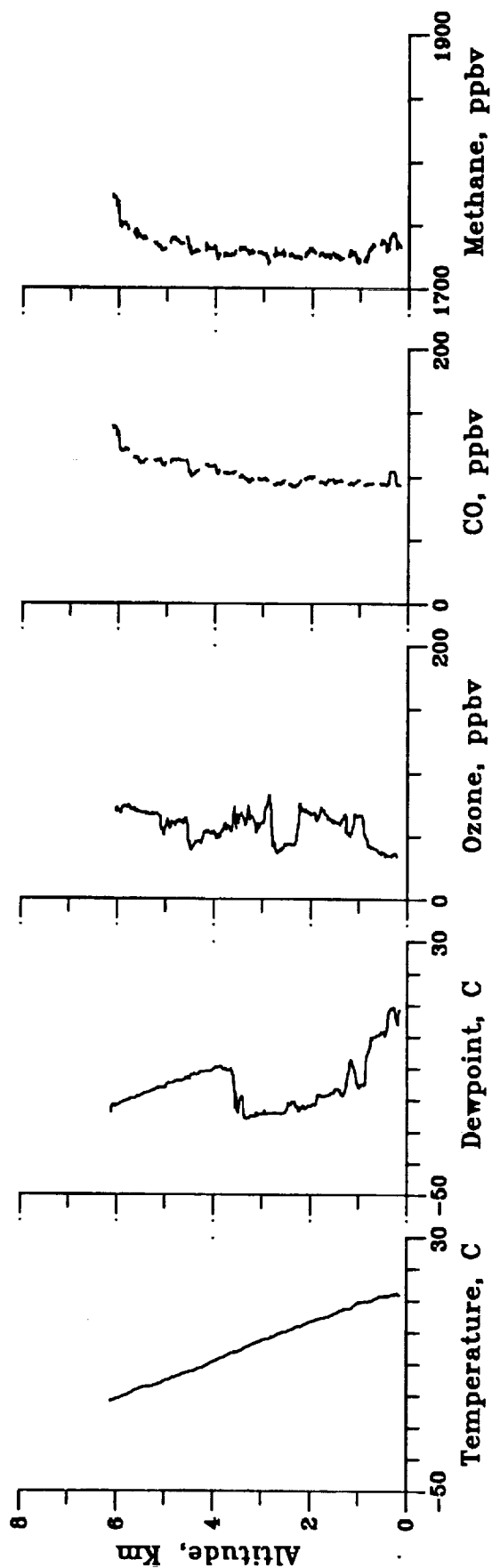


Figure A13.3

ABLE-3A ALASKAN MISSION: FLIGHT 13 PROFILE AT 2045 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 13 PROFILE AT 2245 GMT

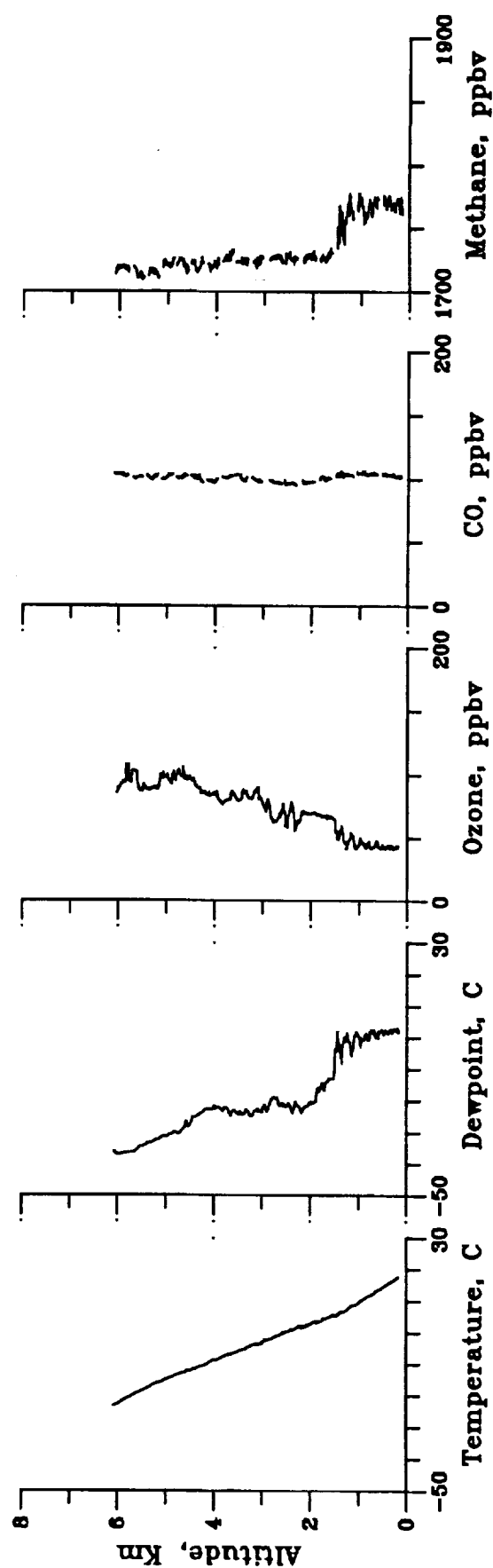


Figure A13.4

ABLE-3A ALASKAN MISSION: FLIGHT 14.

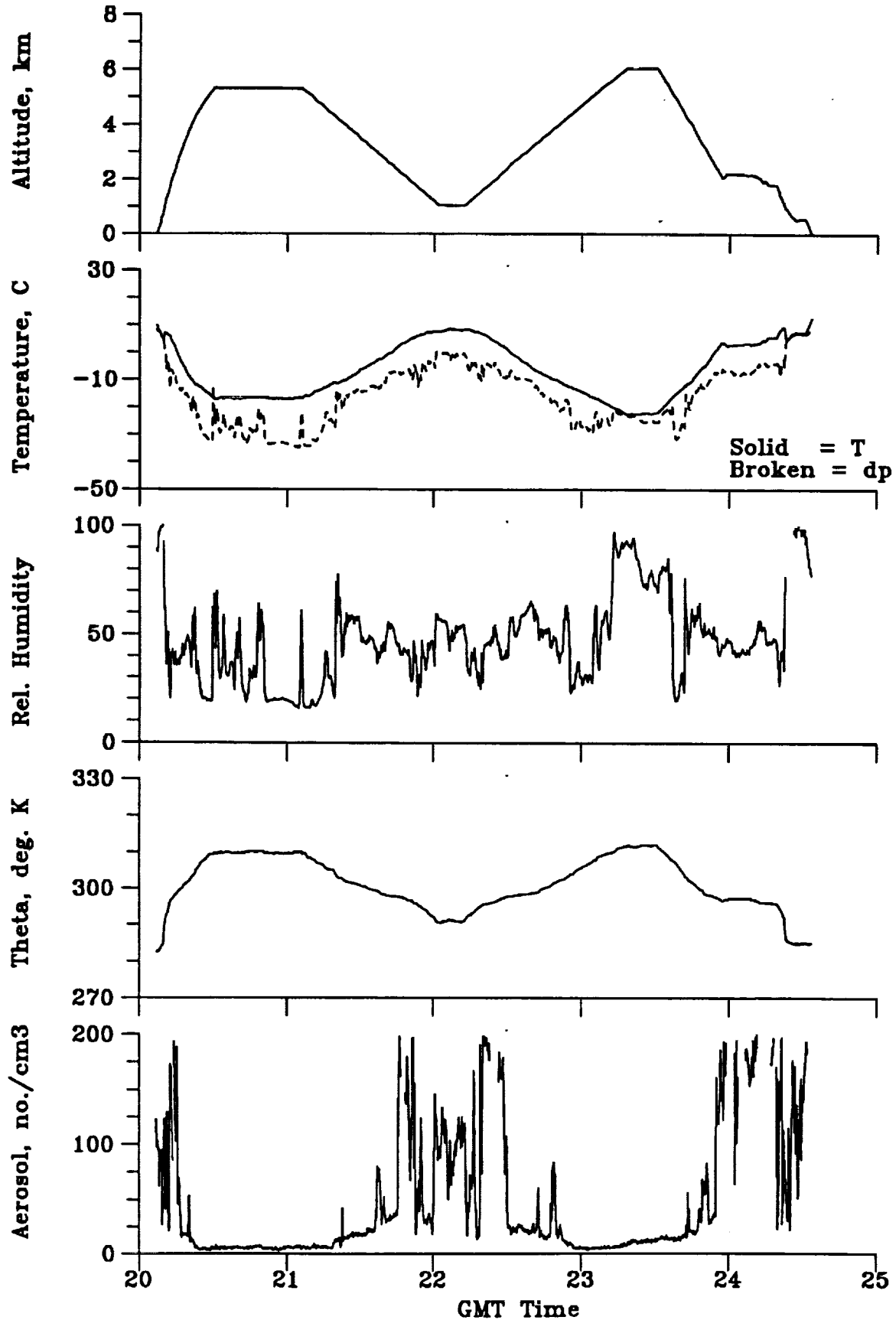


Figure A14.1



# ABLE-3A ALASKAN MISSION: FLIGHT 14.

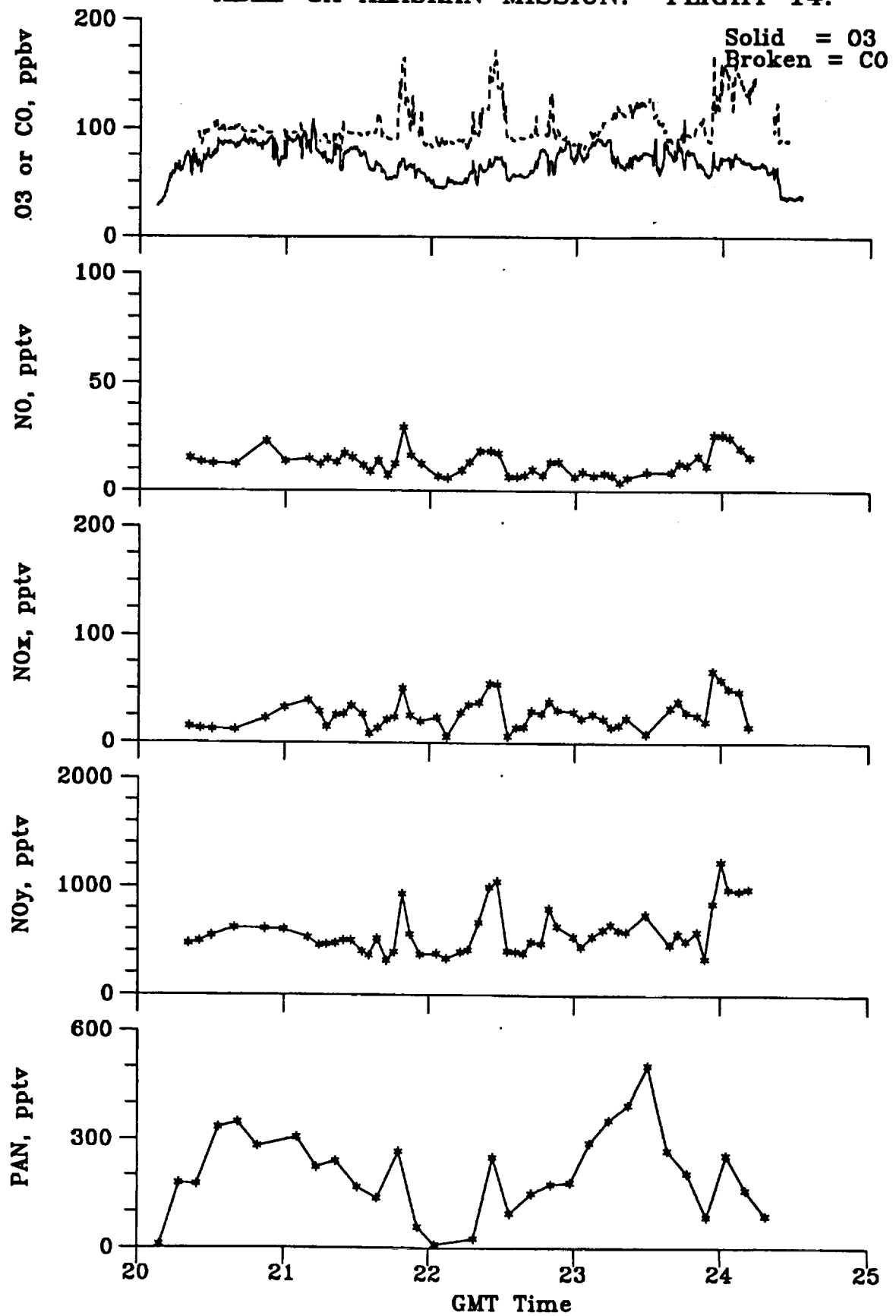


Figure A14.2

ABLE-3A ALASKAN MISSION: FLIGHT 14.

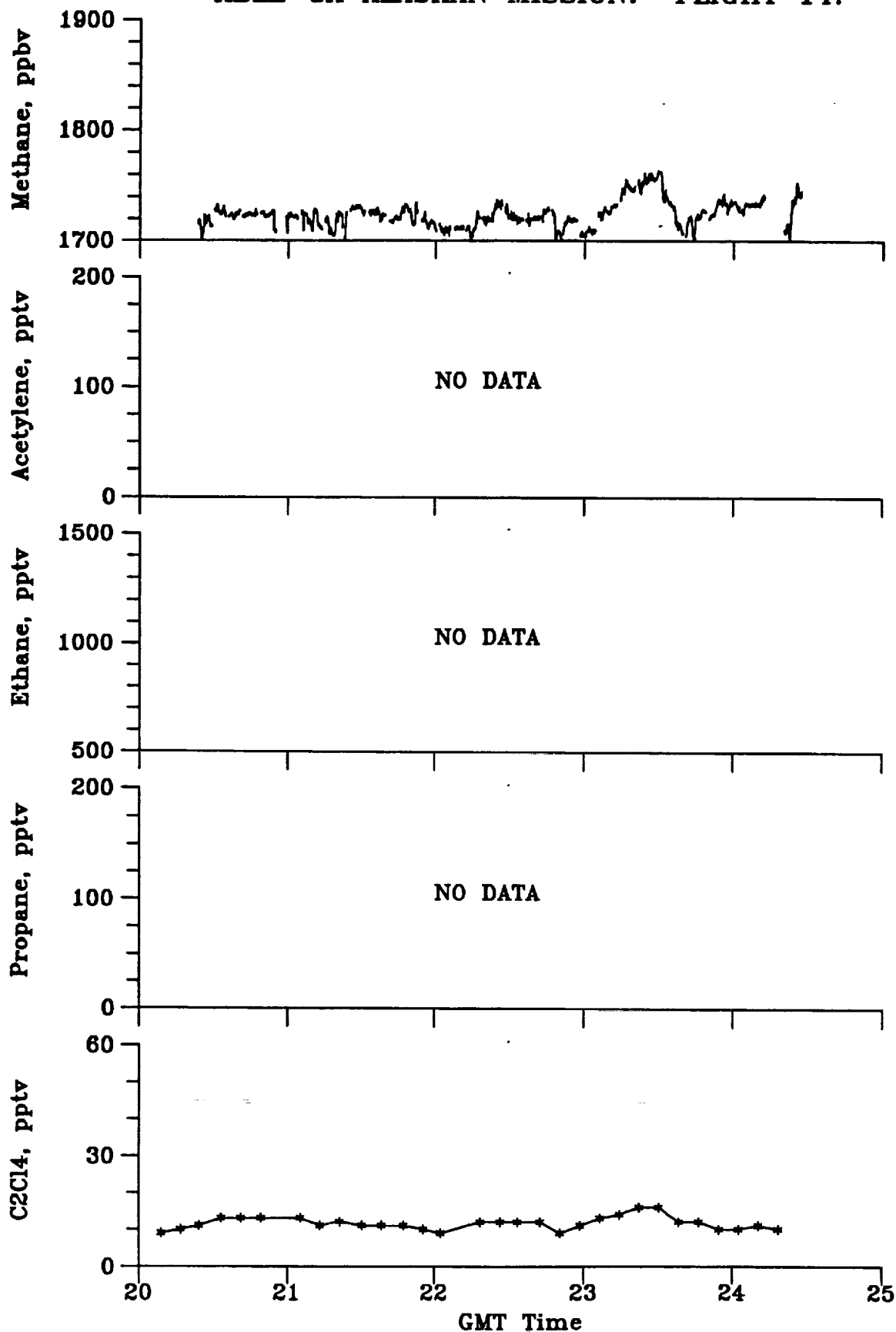


Figure A14.3

ABLE-3A ALASKAN MISSION: FLIGHT 14 PROFILE AT 2130 GMT

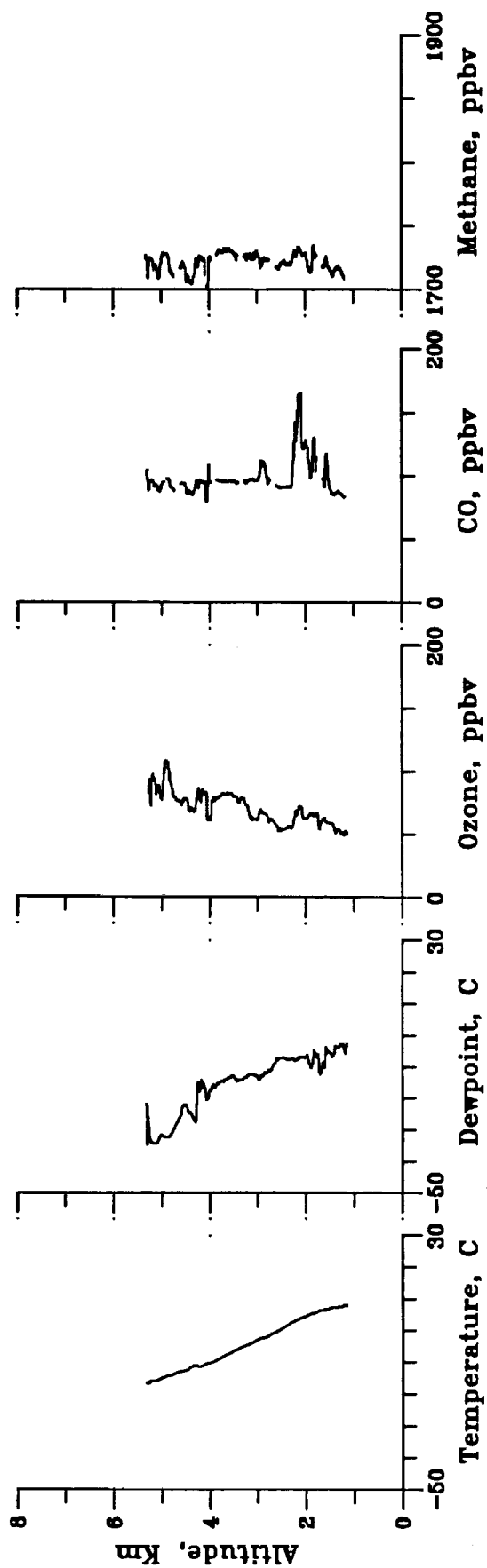


Figure A14.4

ABLE-3A ALASKAN MISSION: FLIGHT 15.

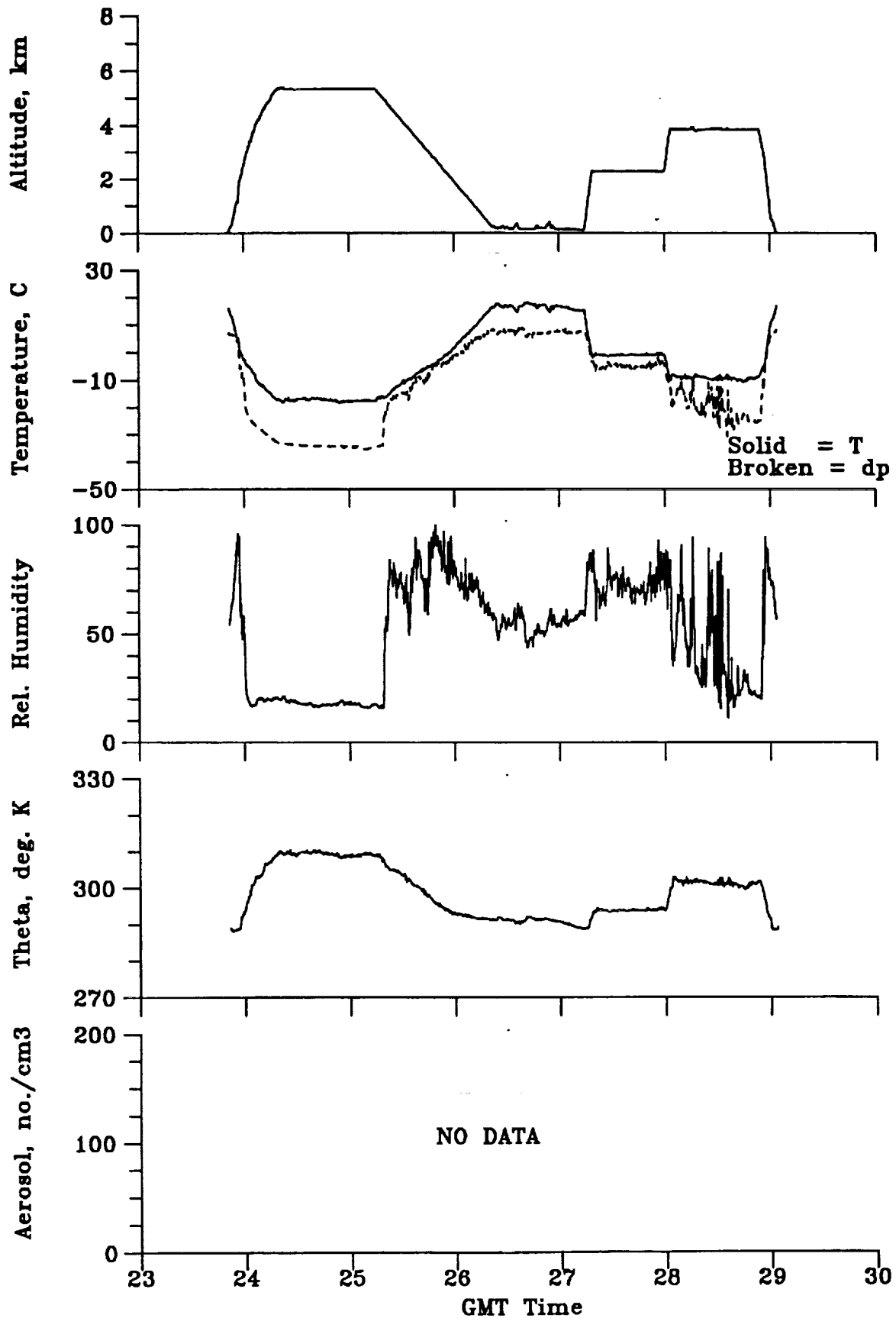


Figure A15.1

# ABLE-3A ALASKAN MISSION: FLIGHT 15.

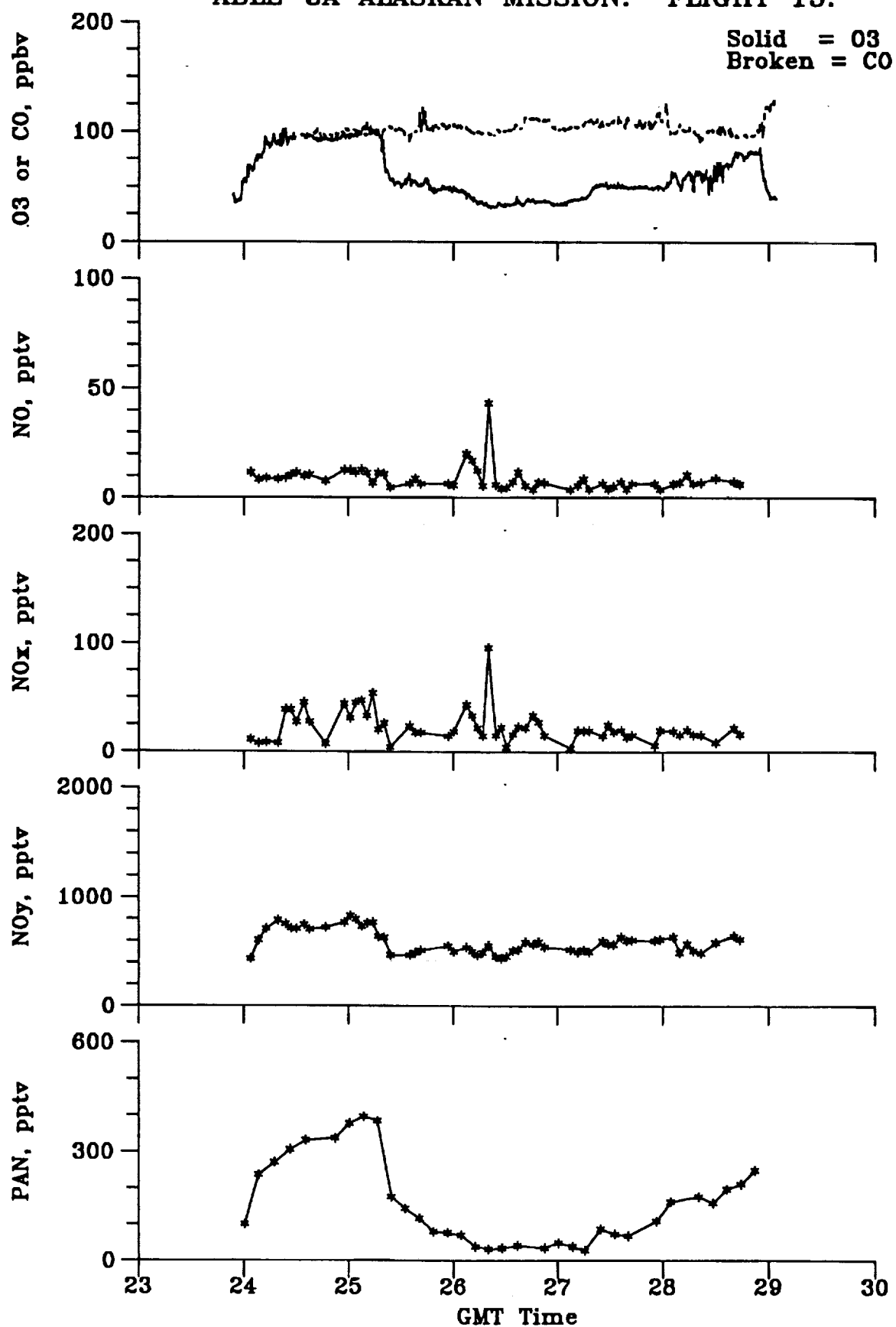


Figure A15.2

# ABLE-3A ALASKAN MISSION: FLIGHT 15.

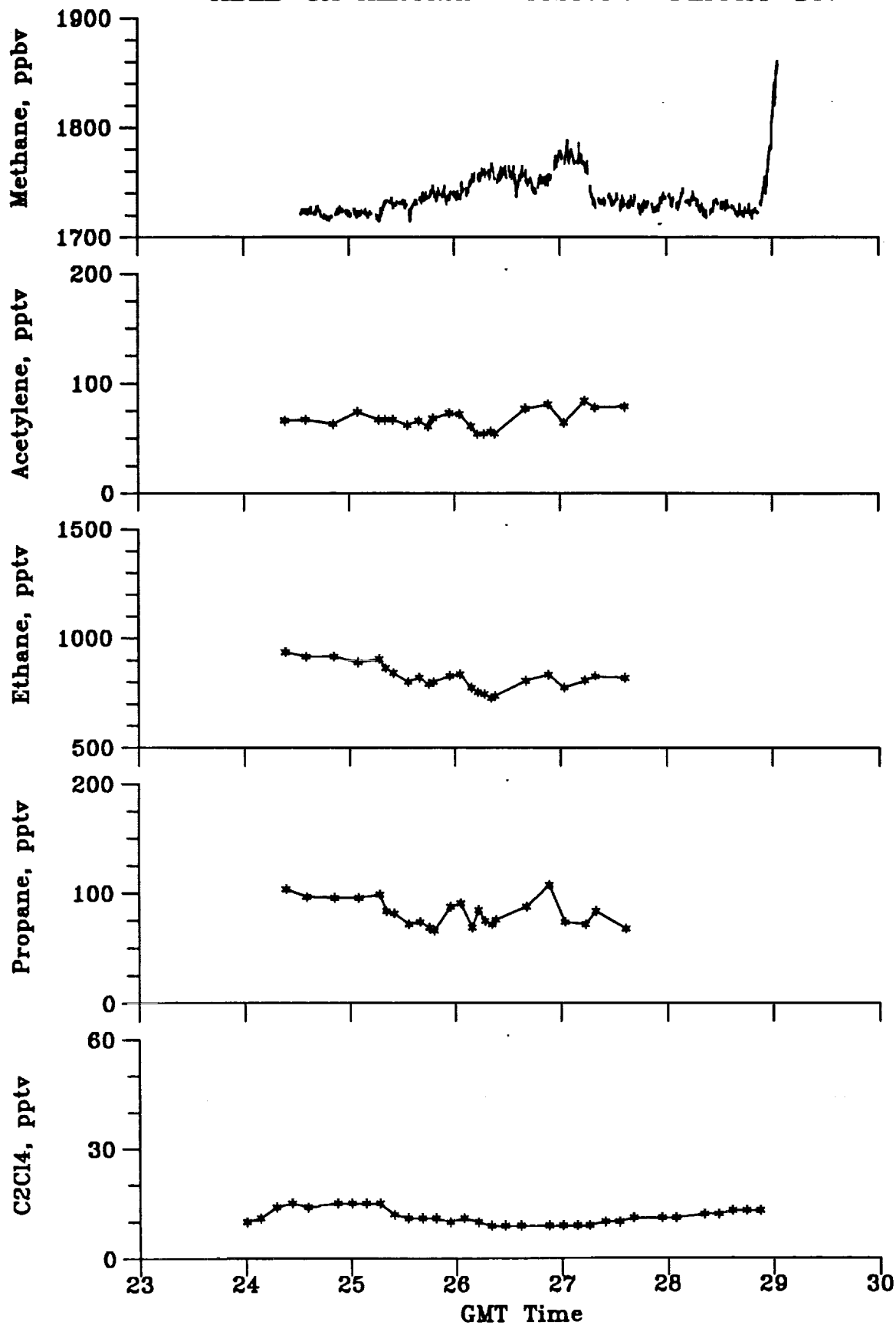


Figure A15.3

ABLE-3A ALASKAN MISSION: FLIGHT 15 PROFILE AT 0200 GMT

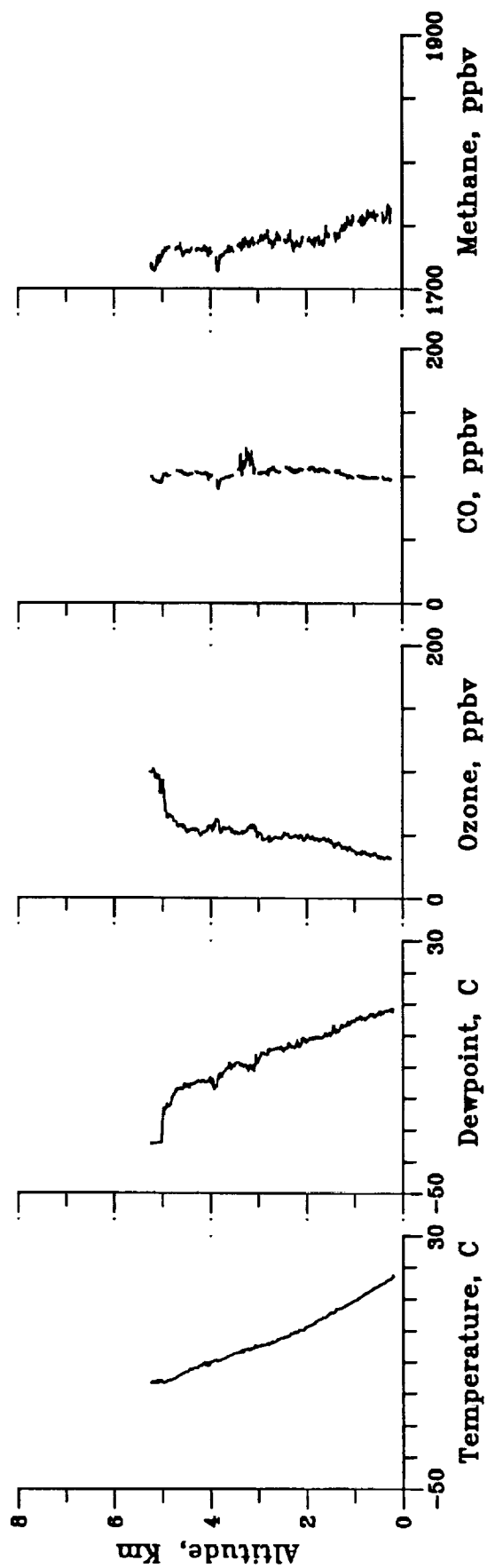


Figure A15.4

ABLE-3A ALASKAN MISSION: FLIGHT 16.

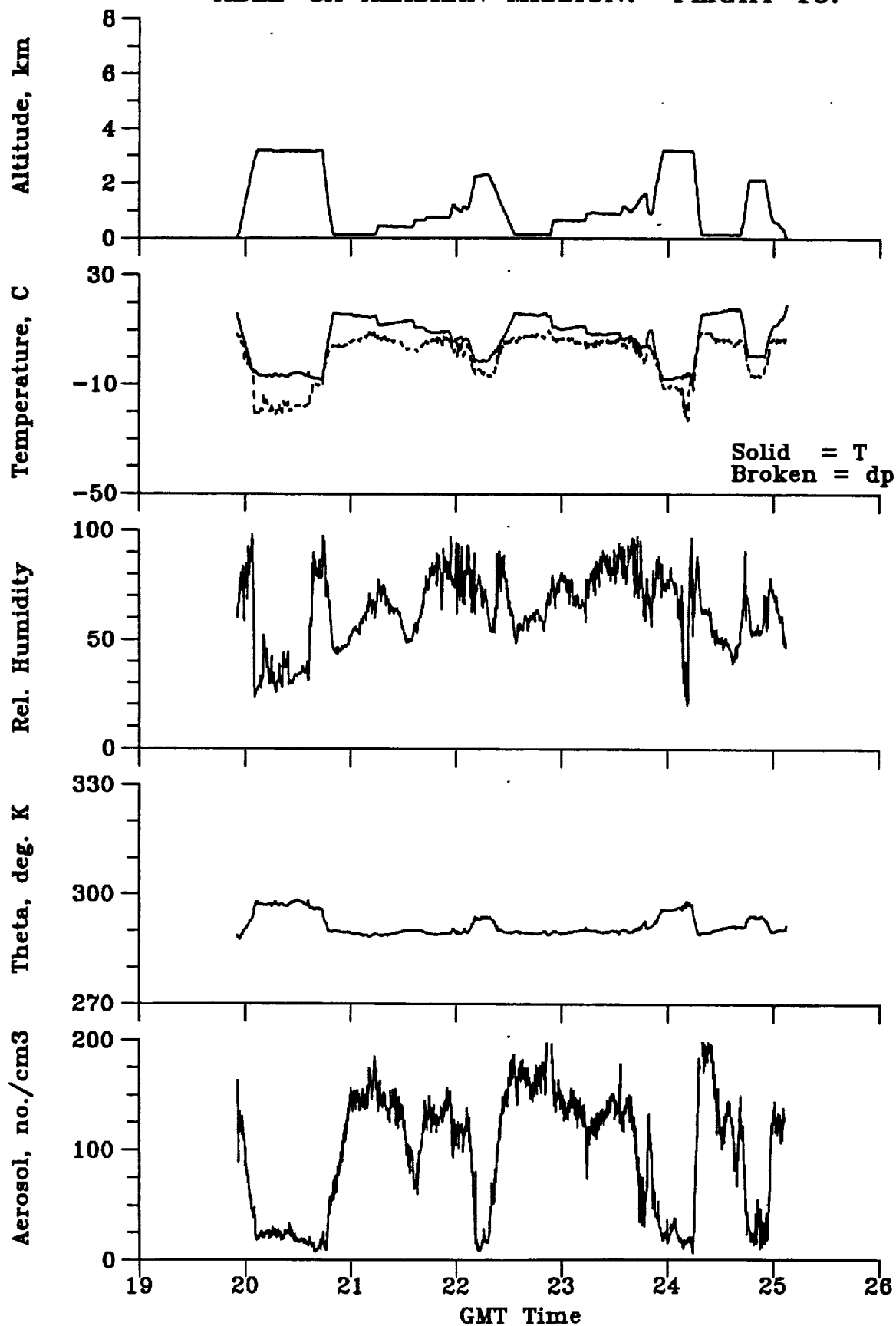


Figure A16.1



# ABLE-3A ALASKAN MISSION: FLIGHT 16.

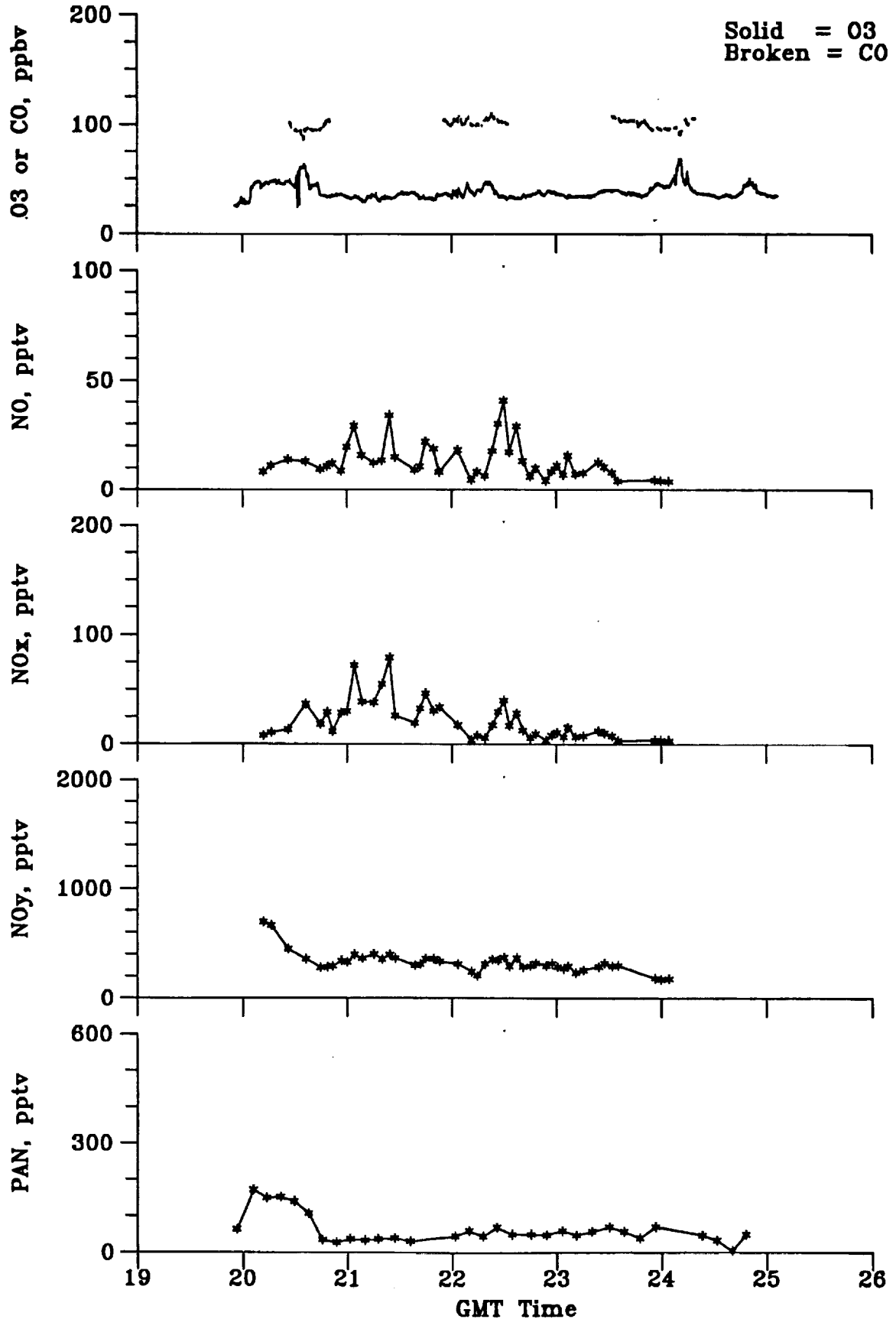


Figure A16.2

# ABLE-3A ALASKAN MISSION: FLIGHT 16.

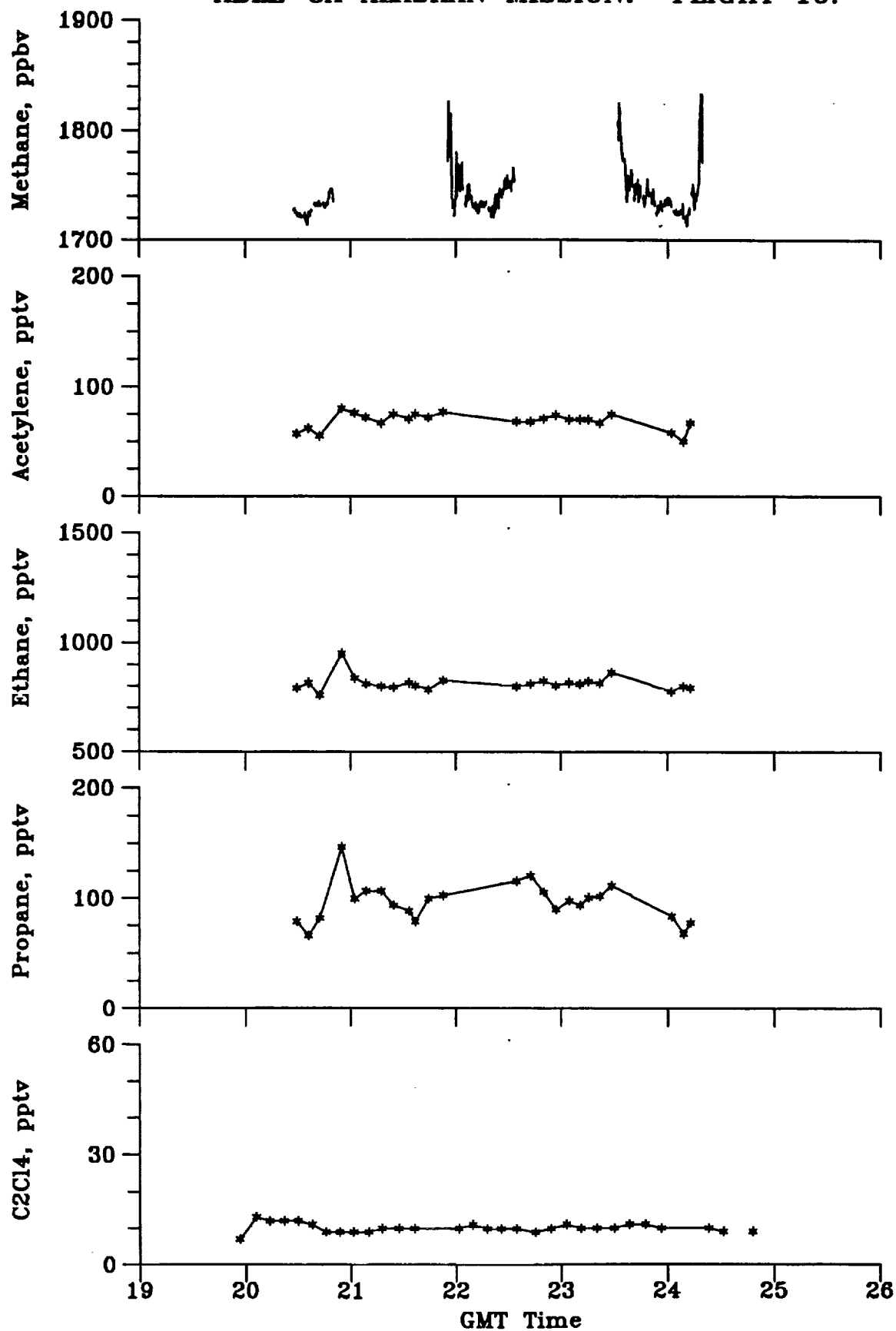
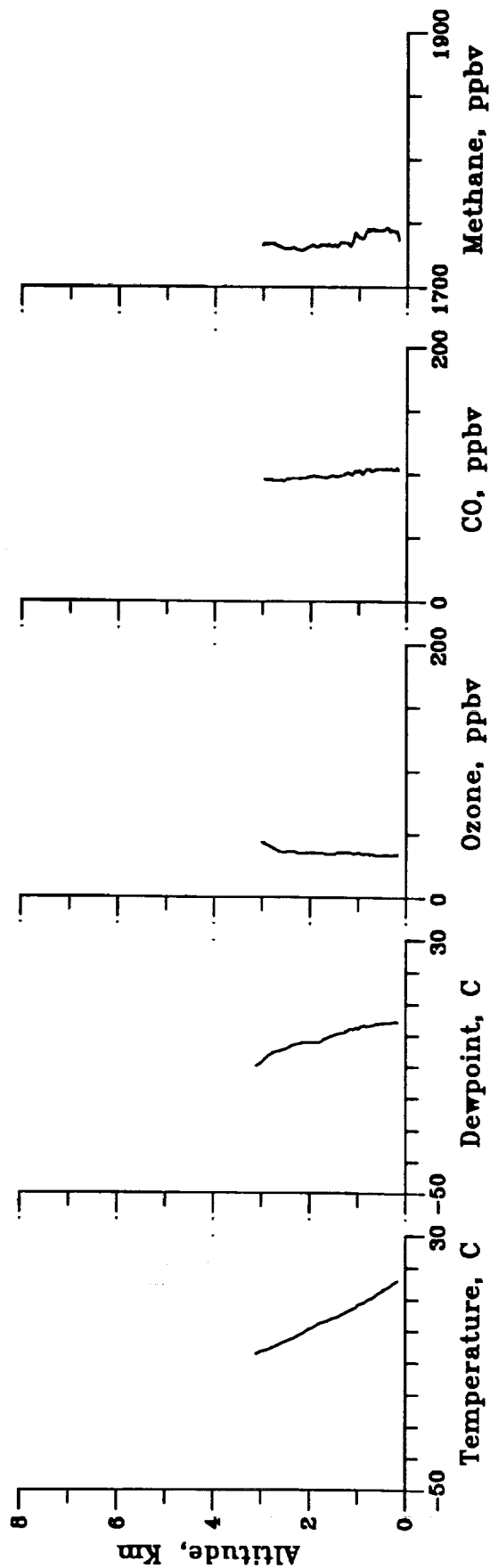


Figure A16.3

ABLE-3A ALASKAN MISSION: FLIGHT 16 PROFILE AT 2045 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 16 PROFILE AT 0015 GMT

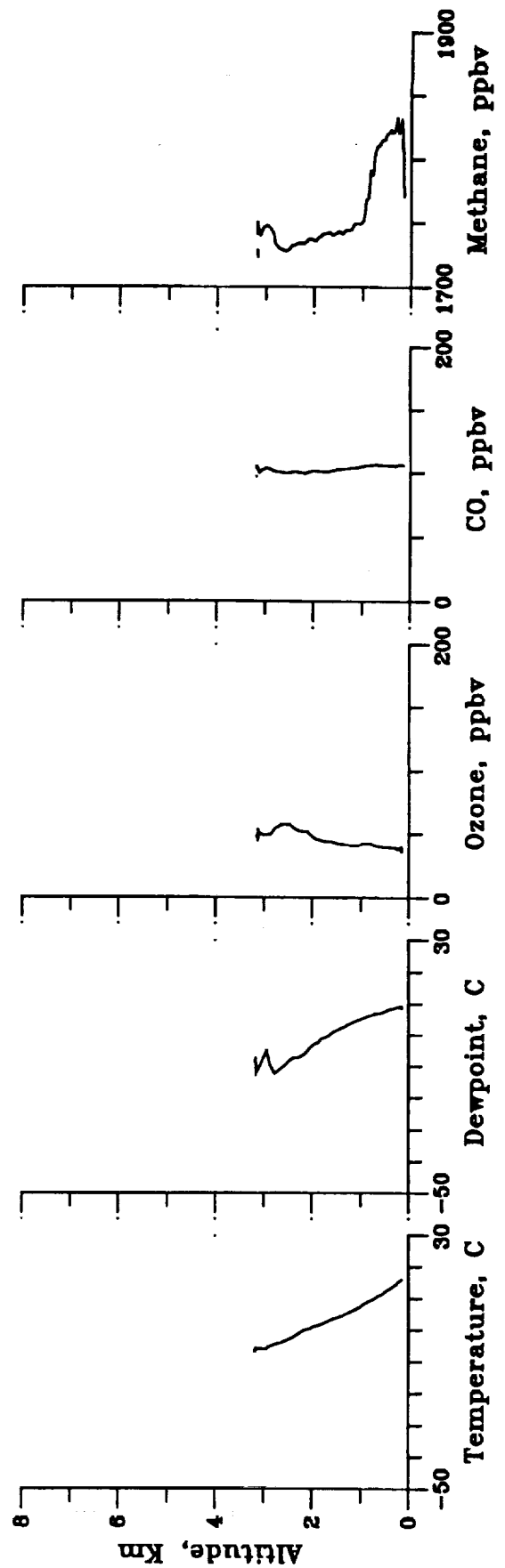


Figure A16.4

# ABLE-3A ALASKAN MISSION: FLIGHT 17.

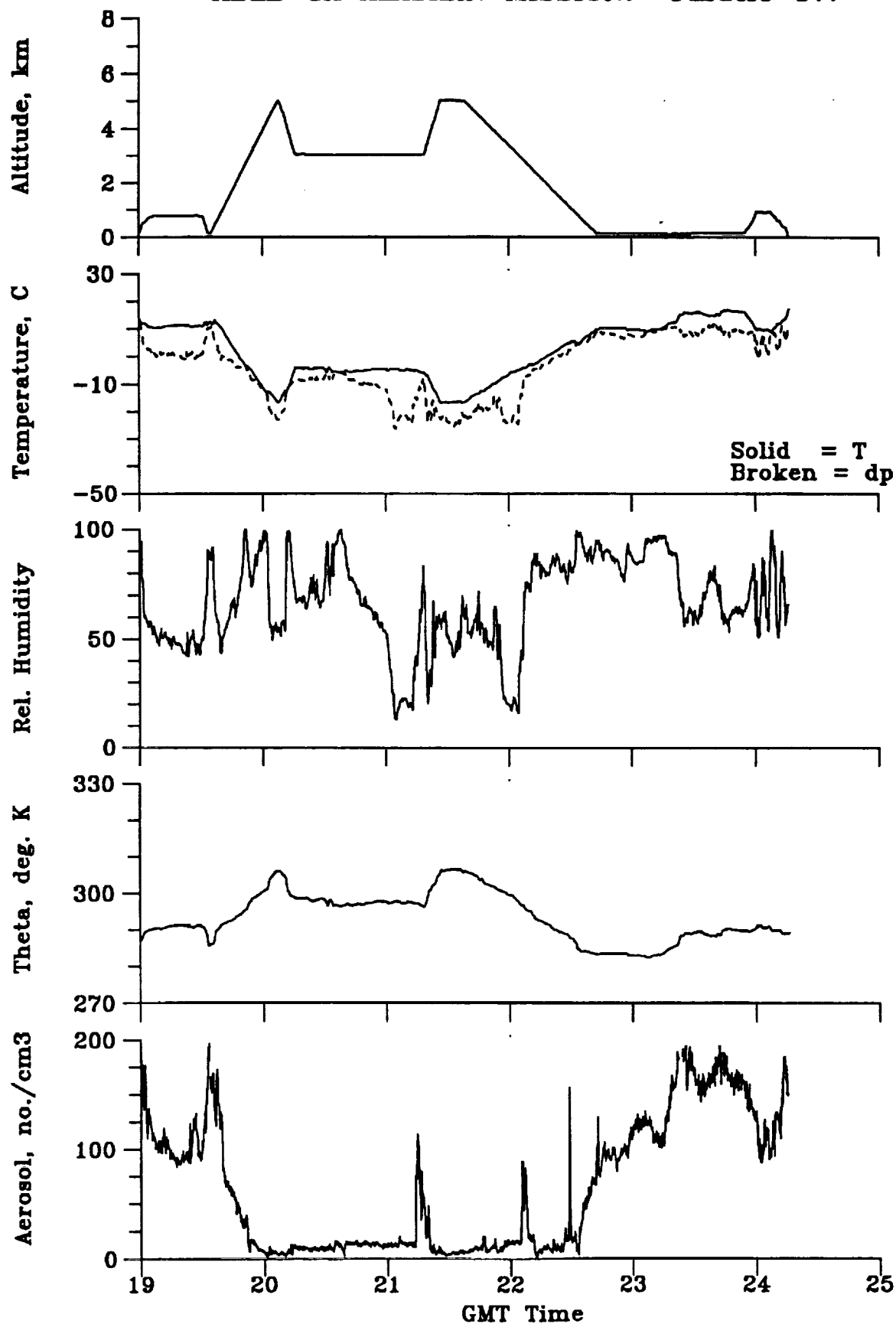


Figure A17.1

# ABLE-3A ALASKAN MISSION: FLIGHT 17.

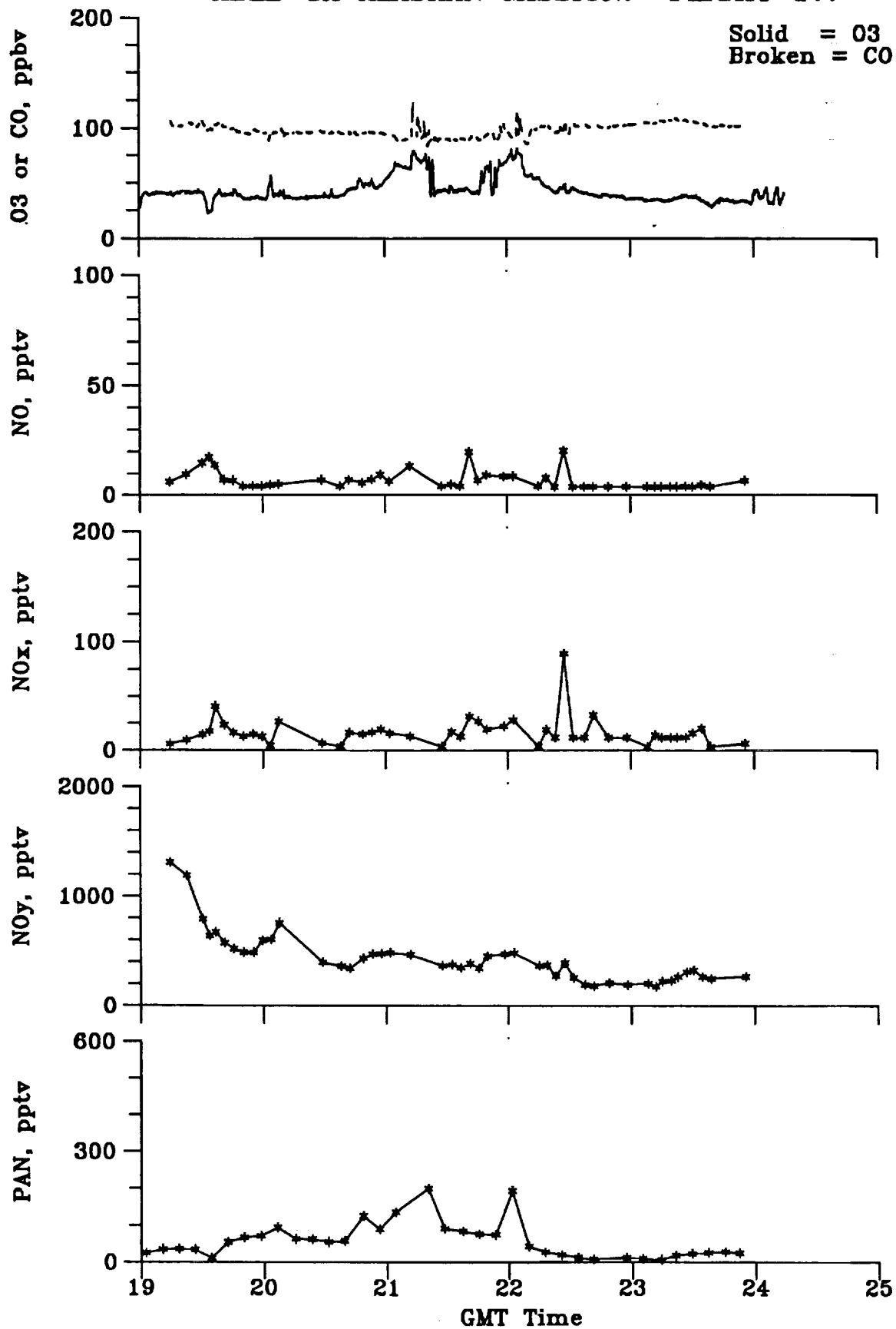


Figure A17.2

ABLE-3A ALASKAN MISSION: FLIGHT 17.

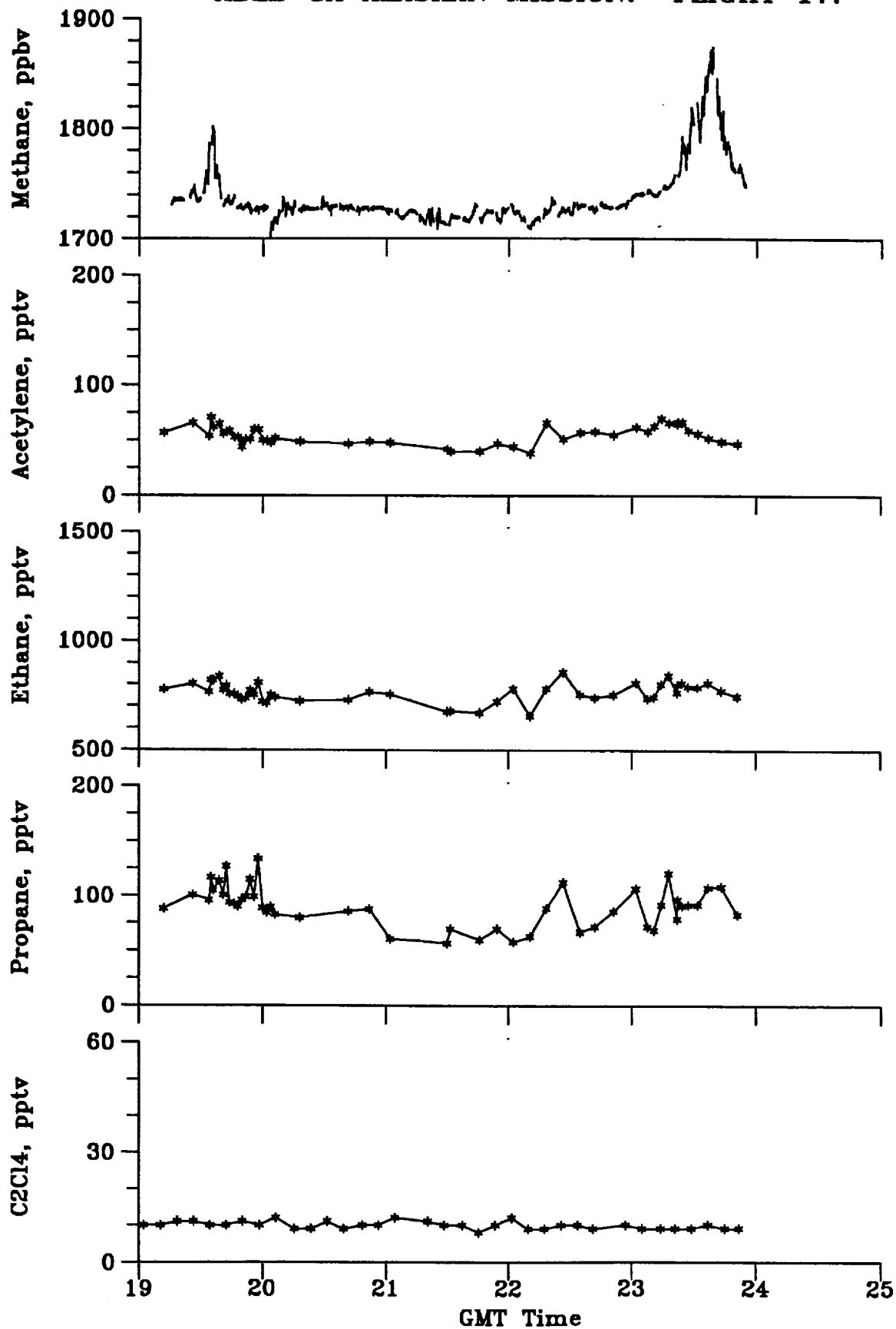
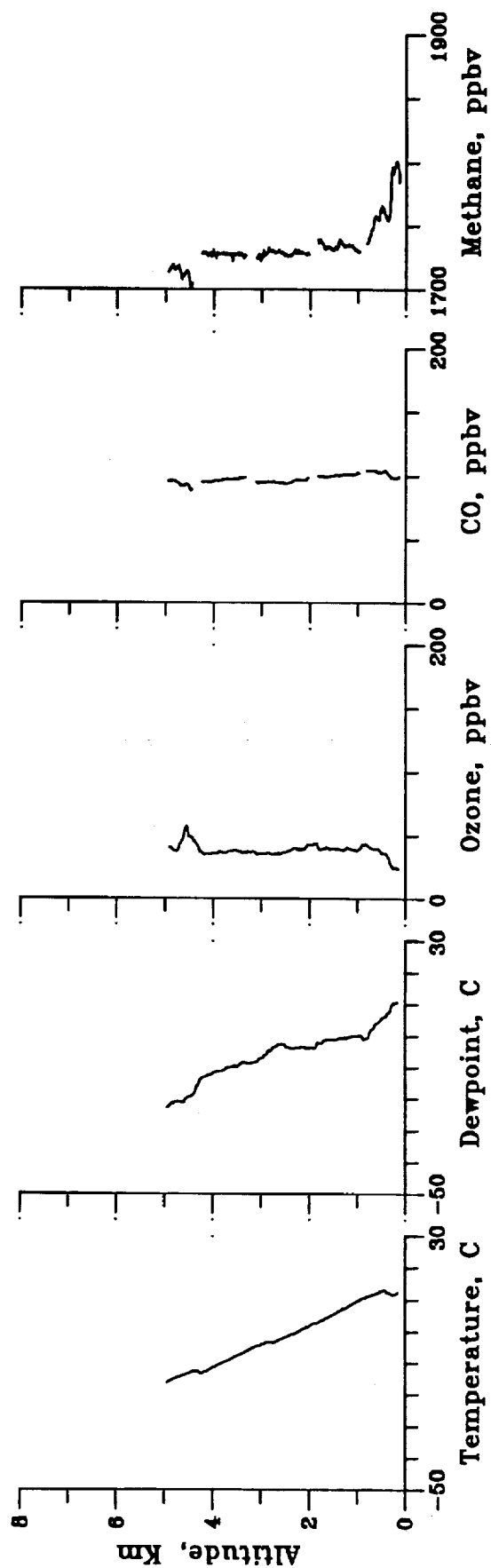


Figure A17.3

ABLE-3A ALASKAN MISSION: FLIGHT 17 PROFILE AT 1945 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 17 PROFILE AT 2215 GMT

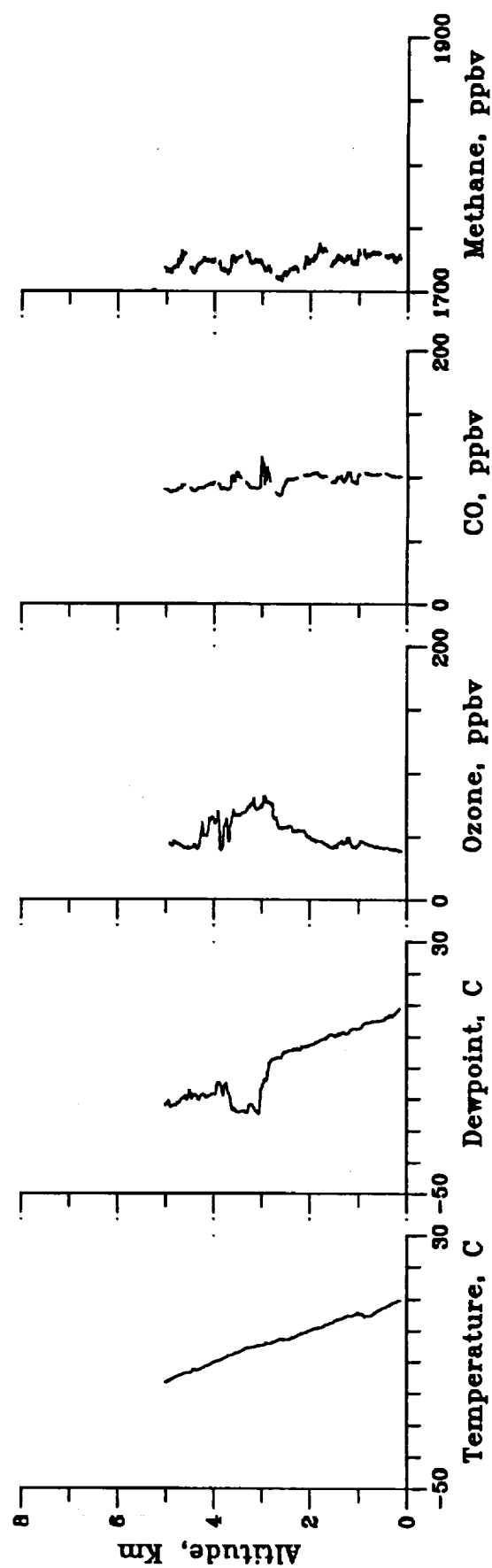


Figure A17.4

ABLE-3A ALASKAN MISSION: FLIGHT 18.

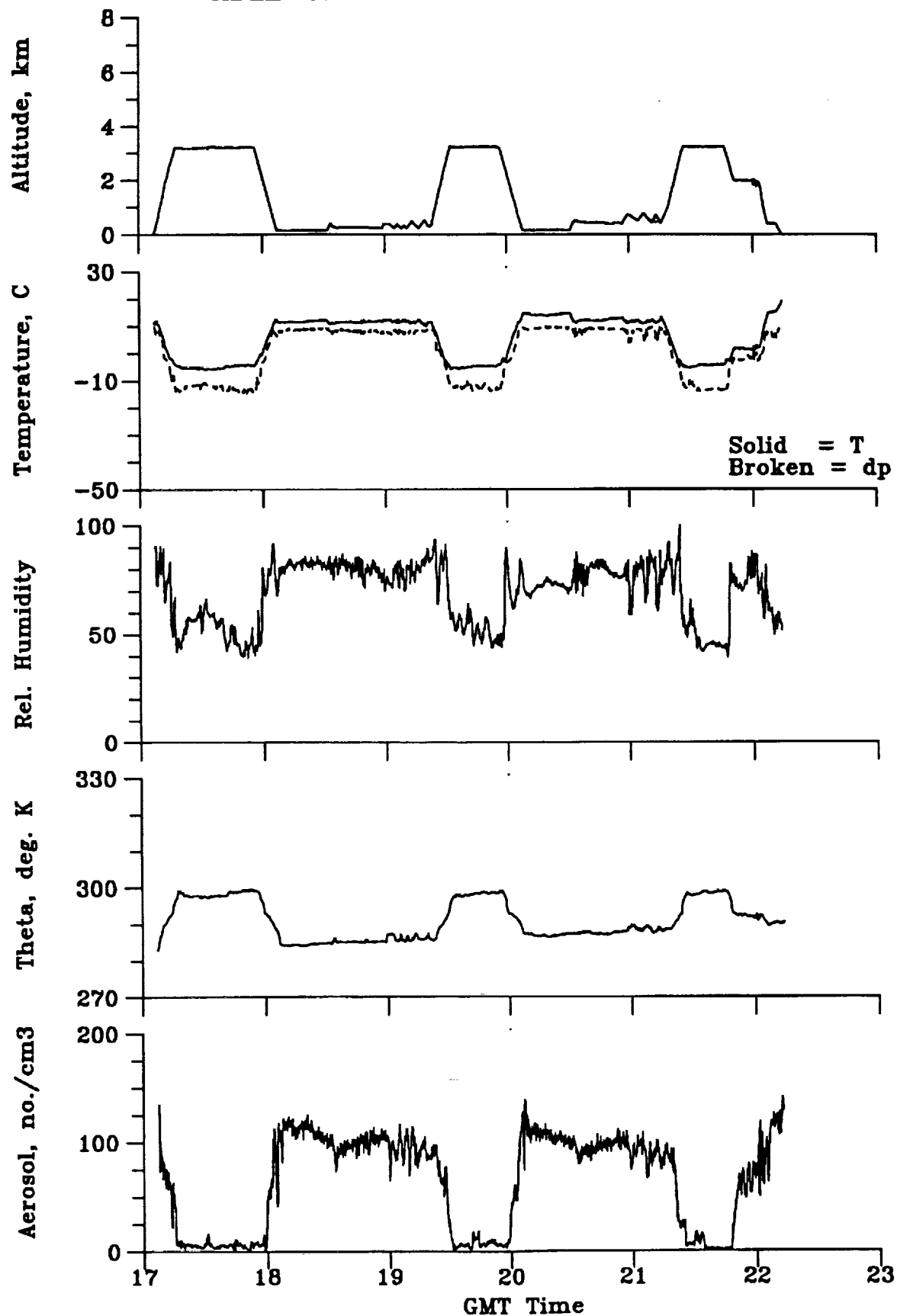


Figure A18.1



# ABLE-3A ALASKAN MISSION: FLIGHT 18.

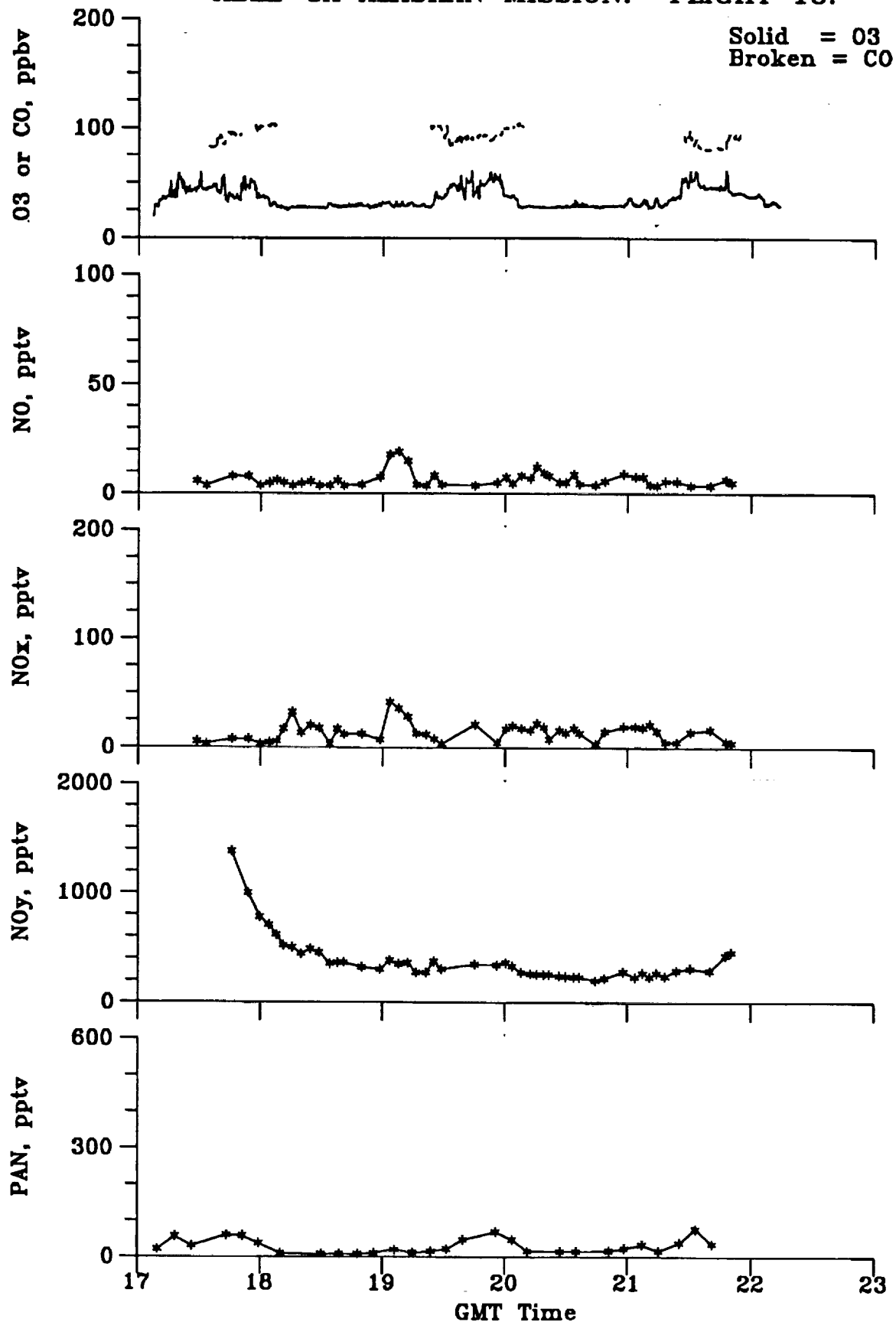


Figure A18.2

# ABLE-3A ALASKAN MISSION: FLIGHT 18.

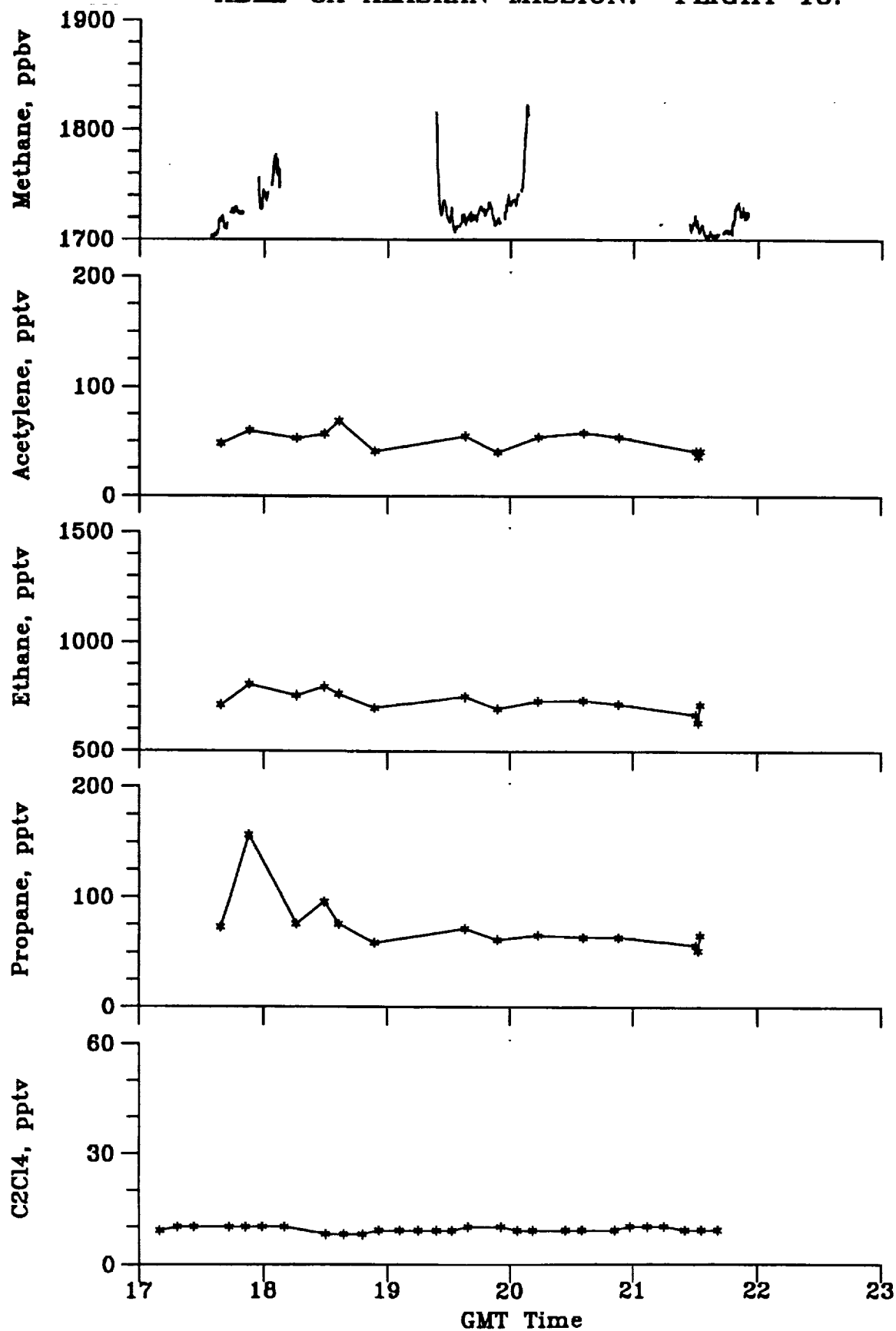
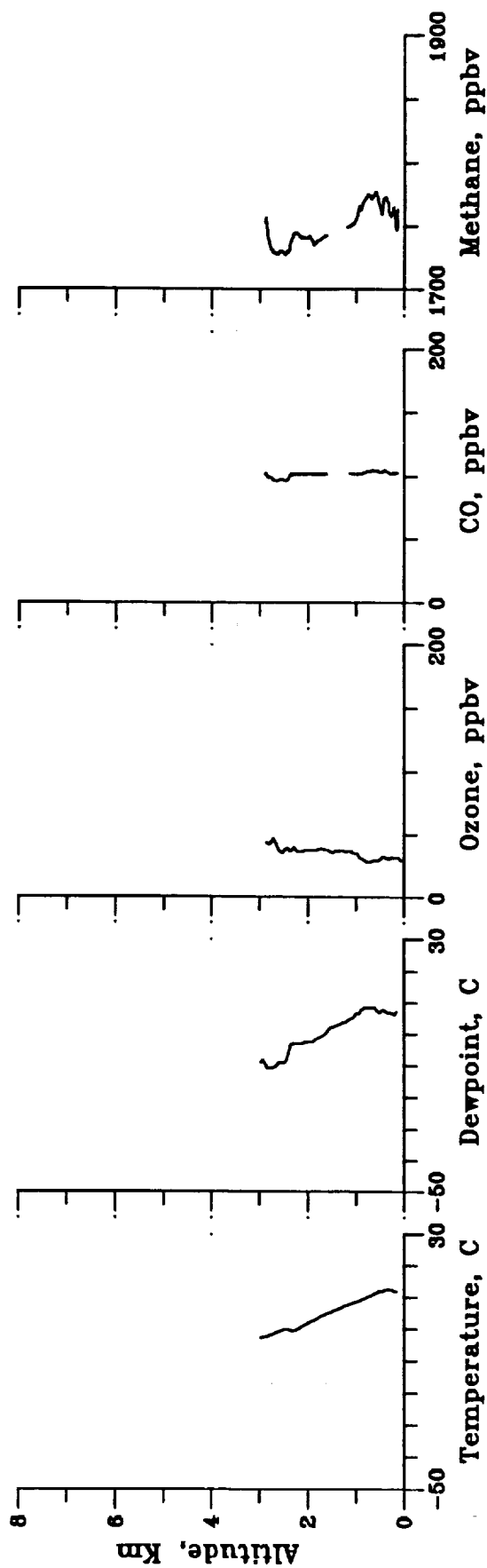


Figure A18.3

ABLE-3A ALASKAN MISSION: FLIGHT 18 PROFILE AT 1800 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 18 PROFILE AT 1930 GMT

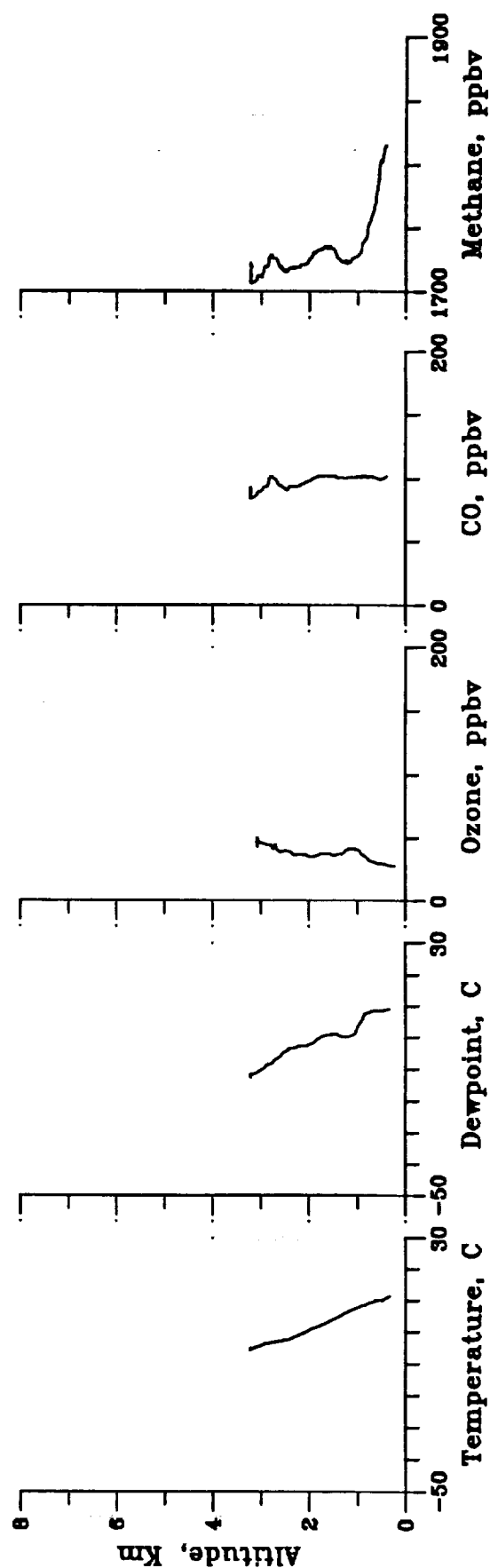


Figure A18.4

# ABLE-3A ALASKAN MISSION: FLIGHT 19.

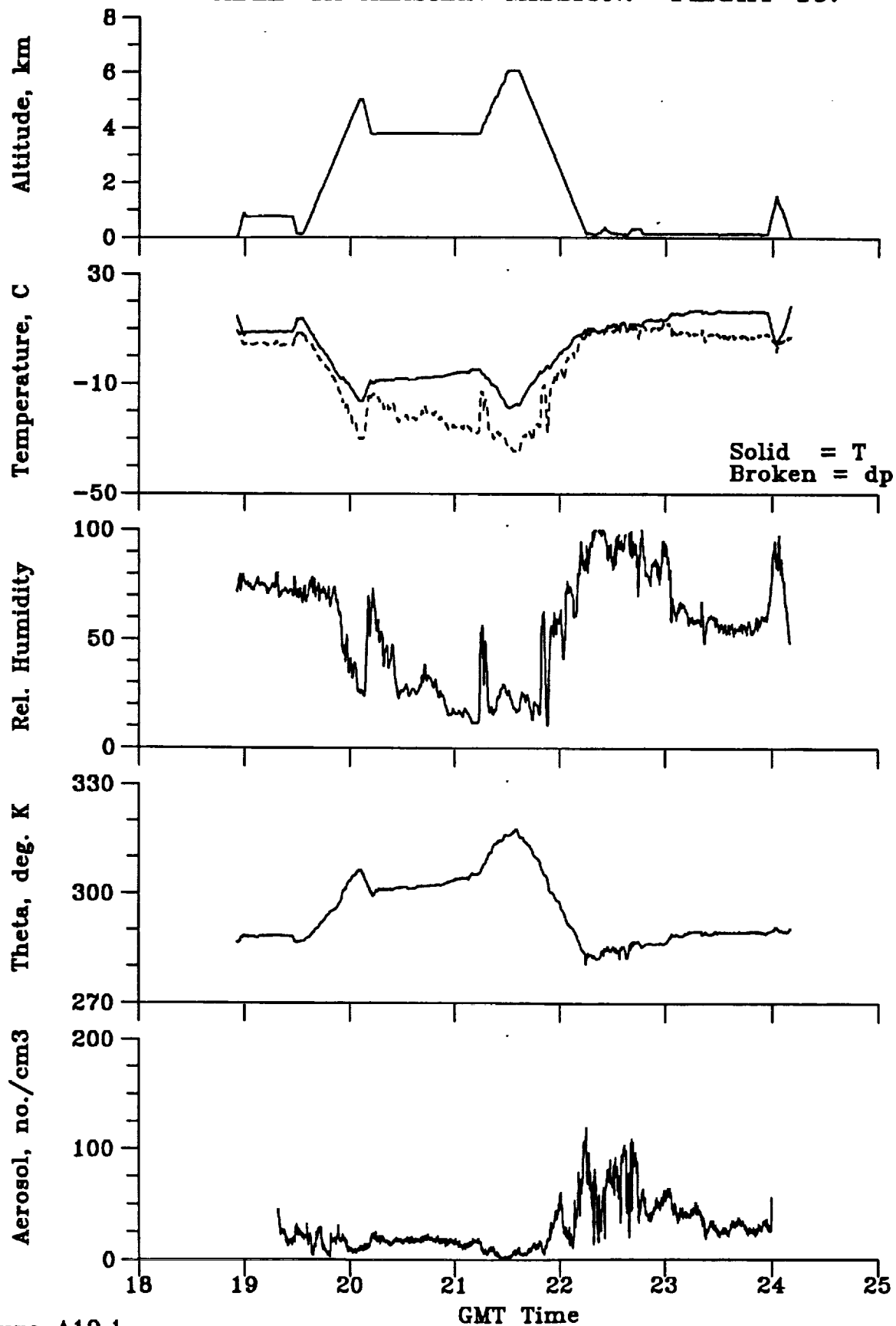


Figure A19.1

# ABLE-3A ALASKAN MISSION: FLIGHT 19.

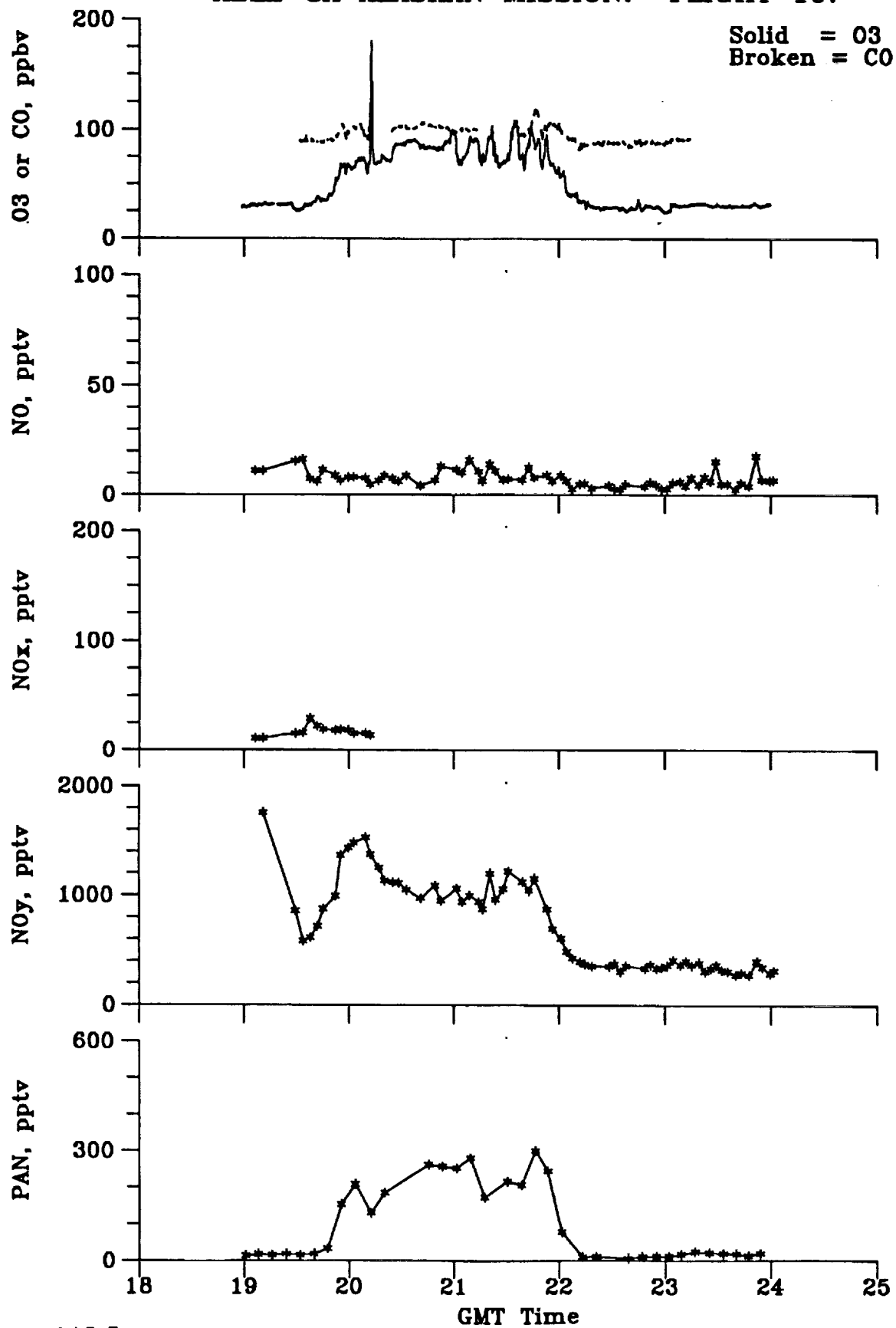


Figure A19.2

# ABLE-3A ALASKAN MISSION: FLIGHT 19.

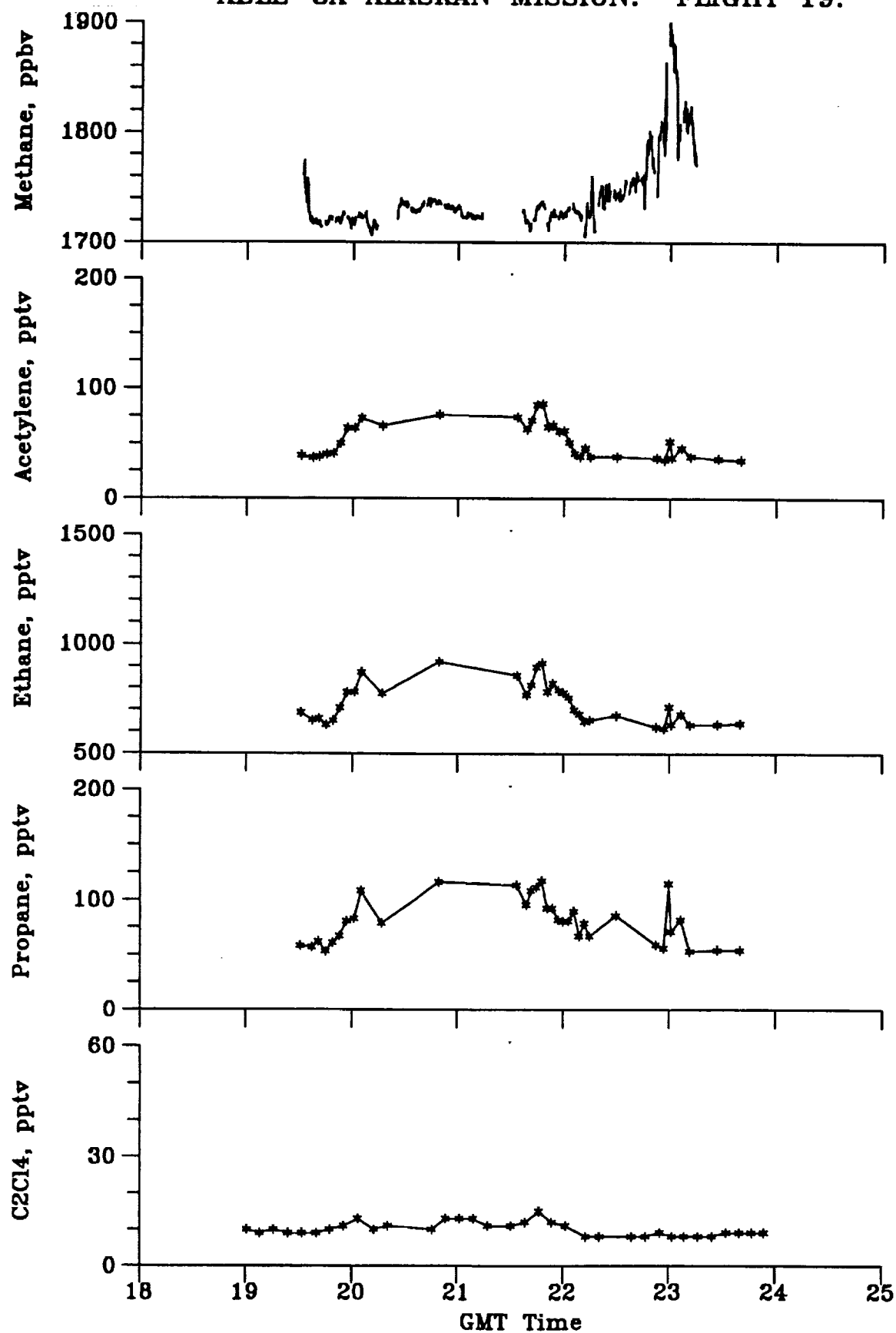
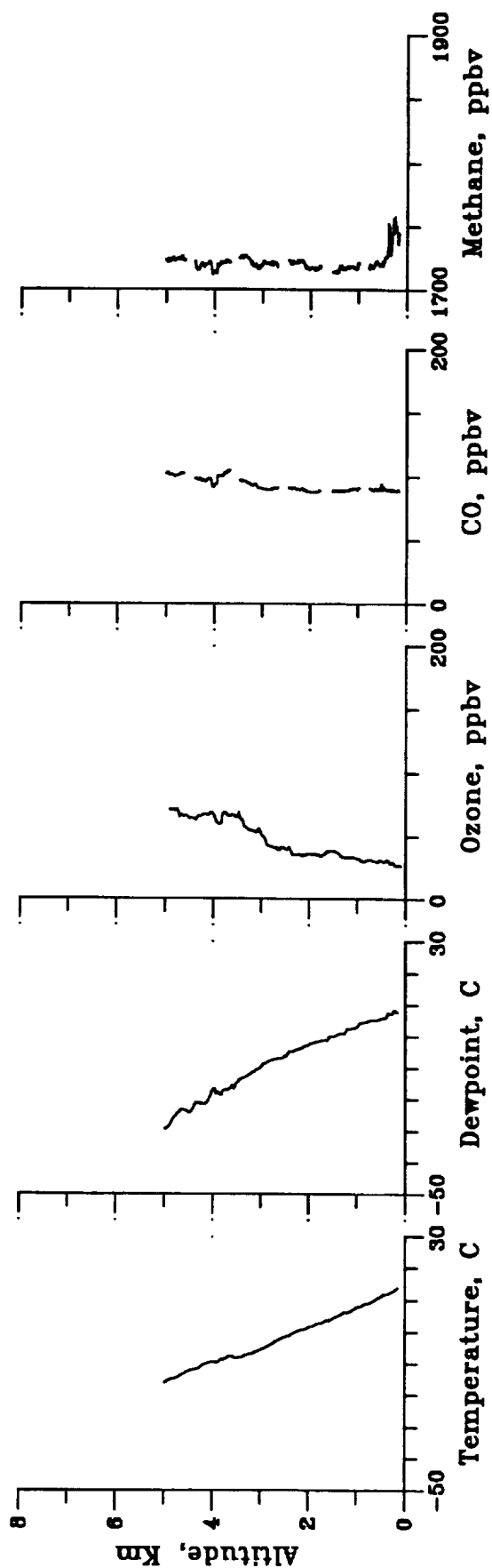


Figure A19.3

ABLE-3A ALASKAN MISSION: FLIGHT 19 PROFILE AT 1945 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 19 PROFILE AT 2200 GMT

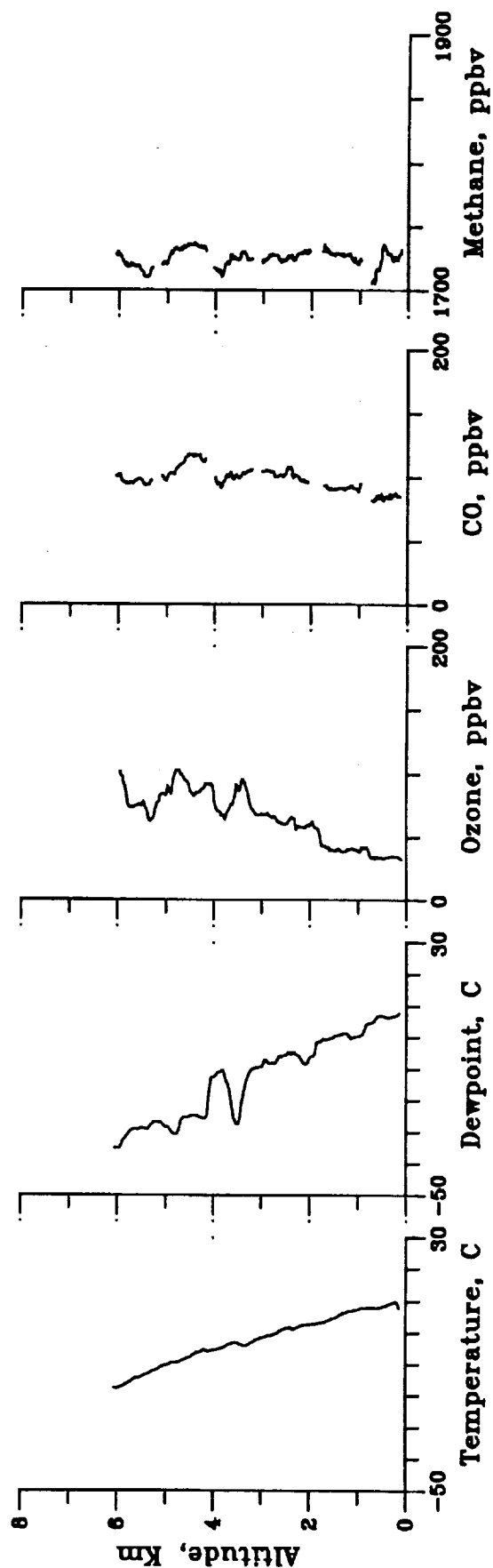


Figure A19.4

# ABLE-3A ALASKAN MISSION: FLIGHT 20.

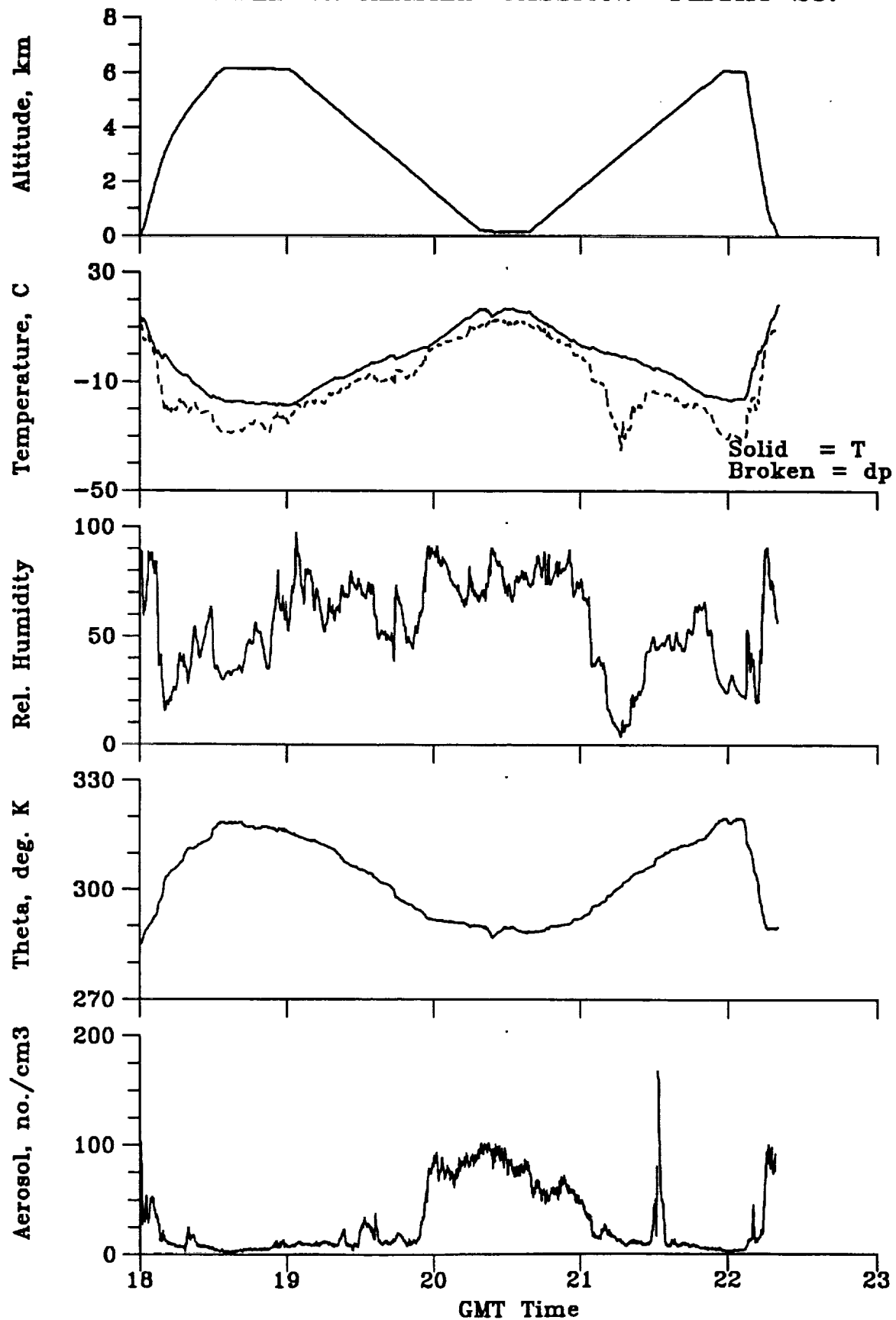


Figure A20.1



# ABLE-3A ALASKAN MISSION: FLIGHT 20.

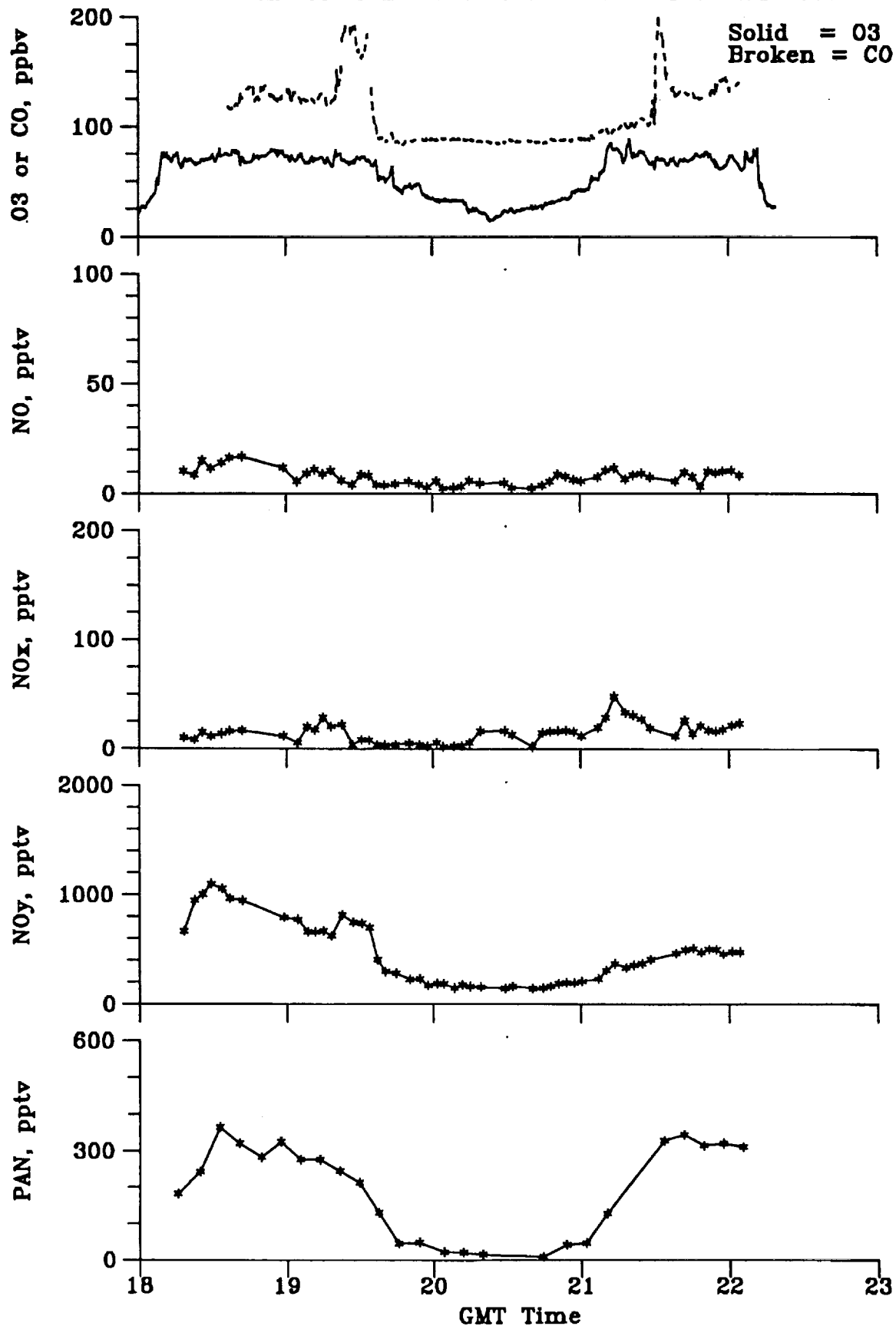


Figure A20.2

# ABLE-3A ALASKAN MISSION: FLIGHT 20.

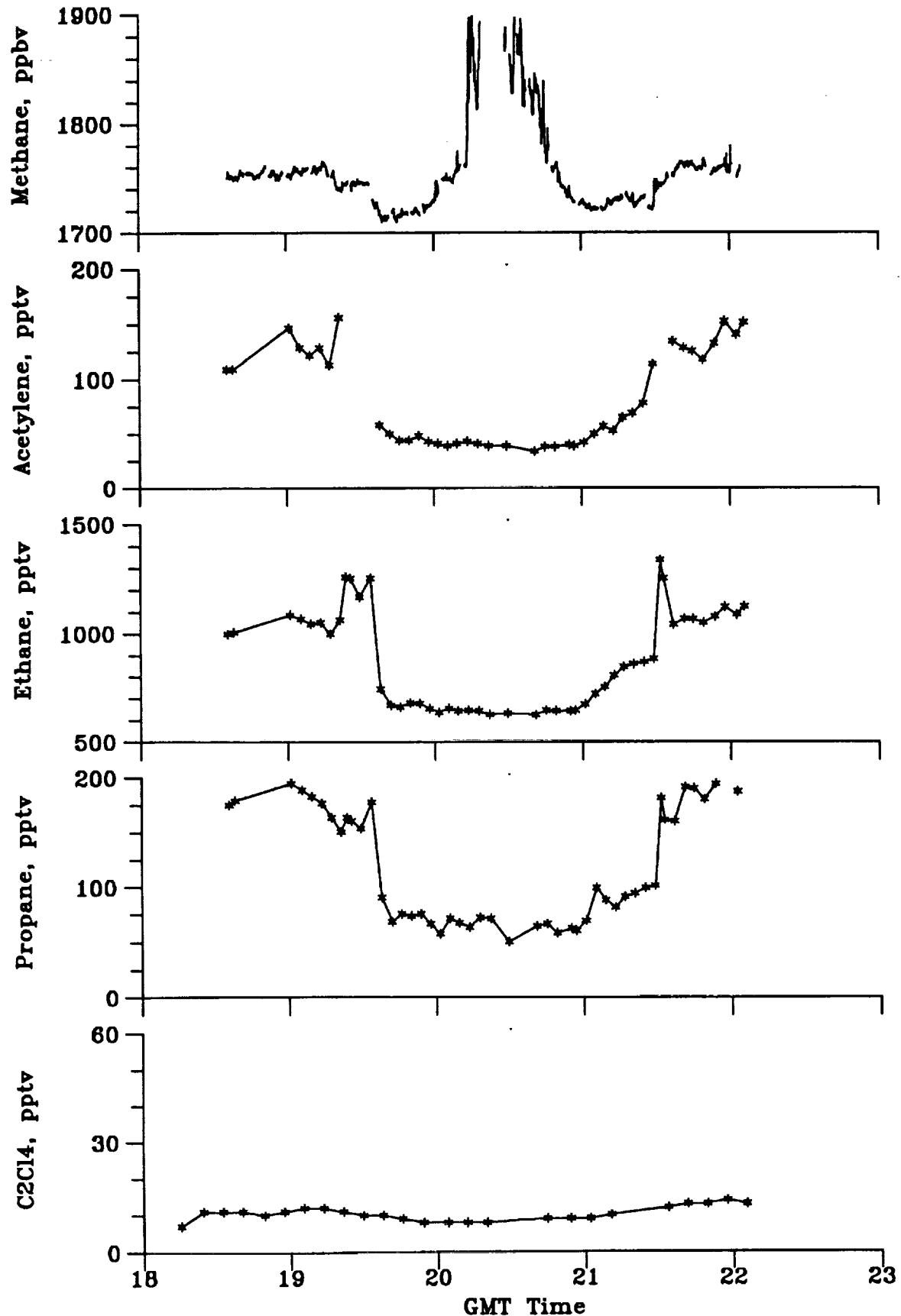
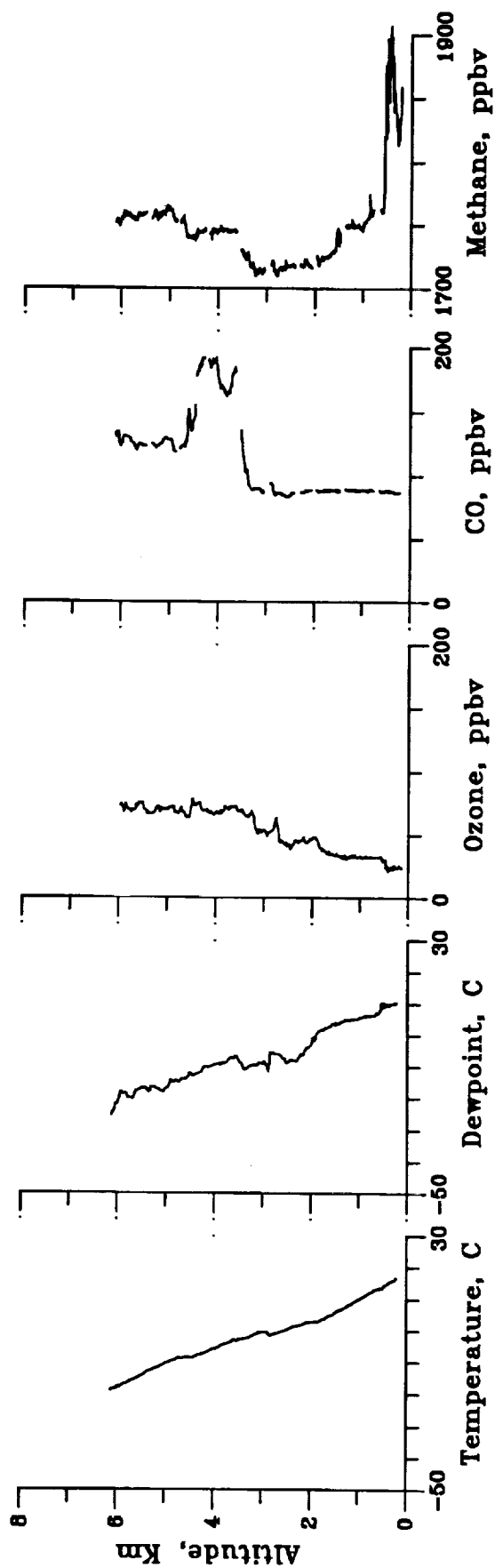


Figure A20.3

ABLE-3A ALASKAN MISSION: FLIGHT 20 PROFILE AT 1930 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 20 PROFILE AT 2115 GMT

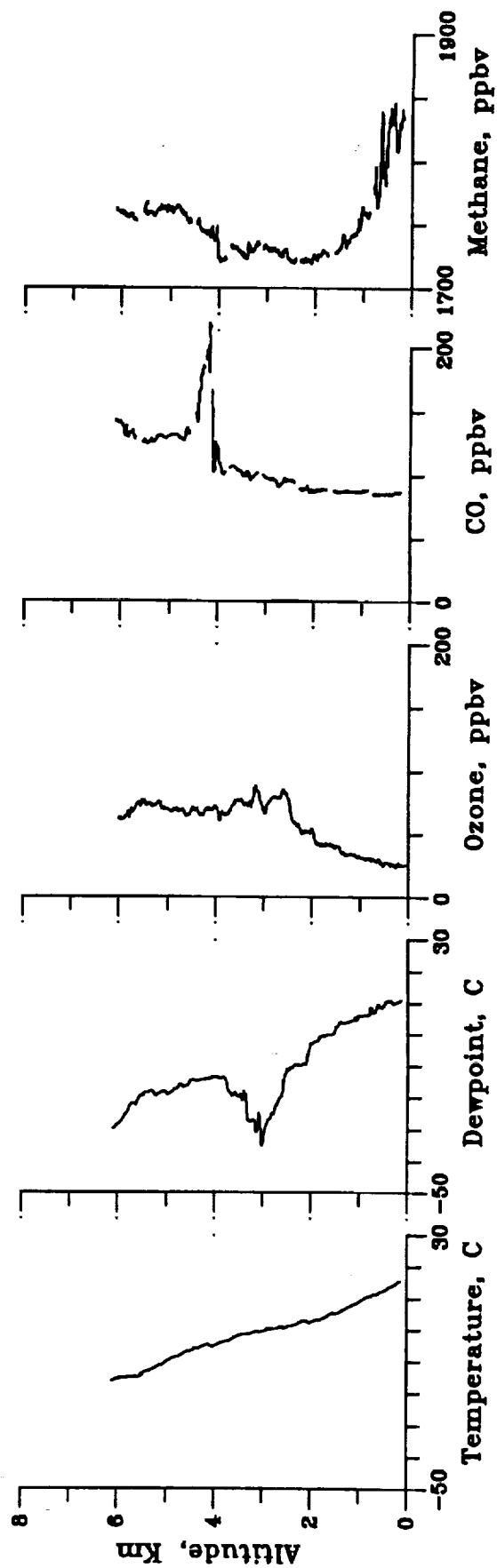


Figure A20.4

# ABLE-3A ALASKAN MISSION: FLIGHT 21.

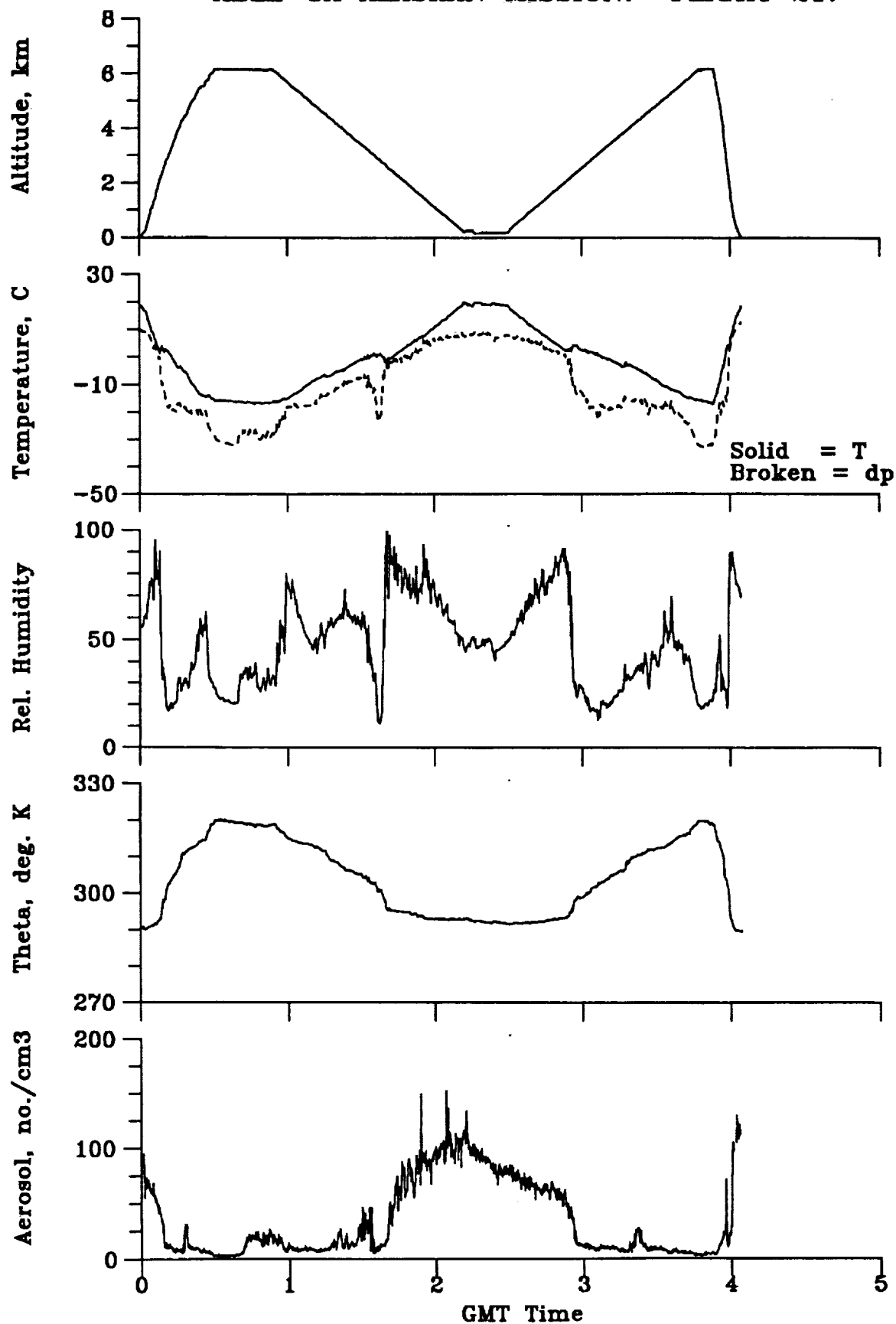


Figure A21.1

# ABLE-3A ALASKAN MISSION: FLIGHT 21.

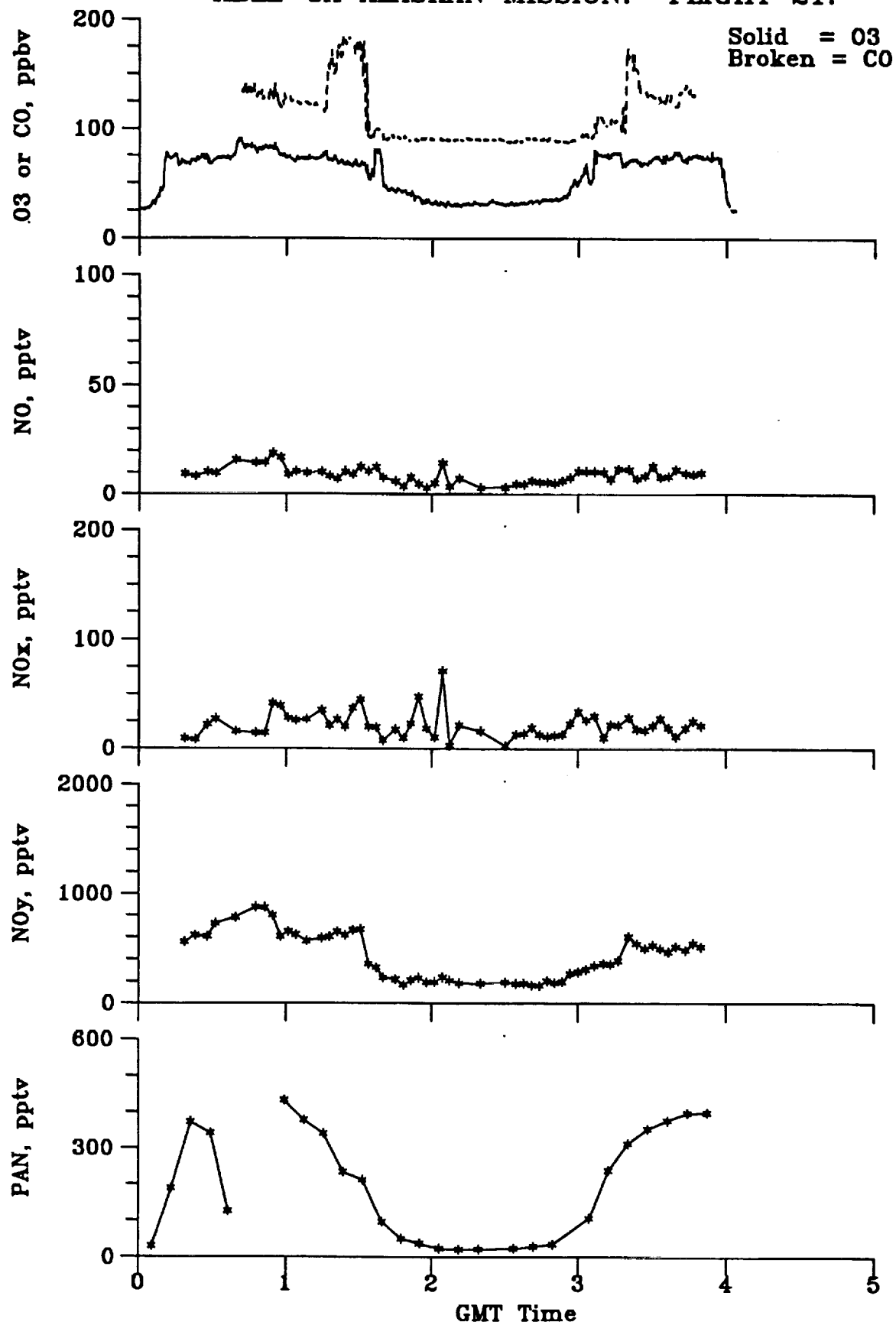


Figure A21.2

ABLE-3A ALASKAN MISSION: FLIGHT 21.

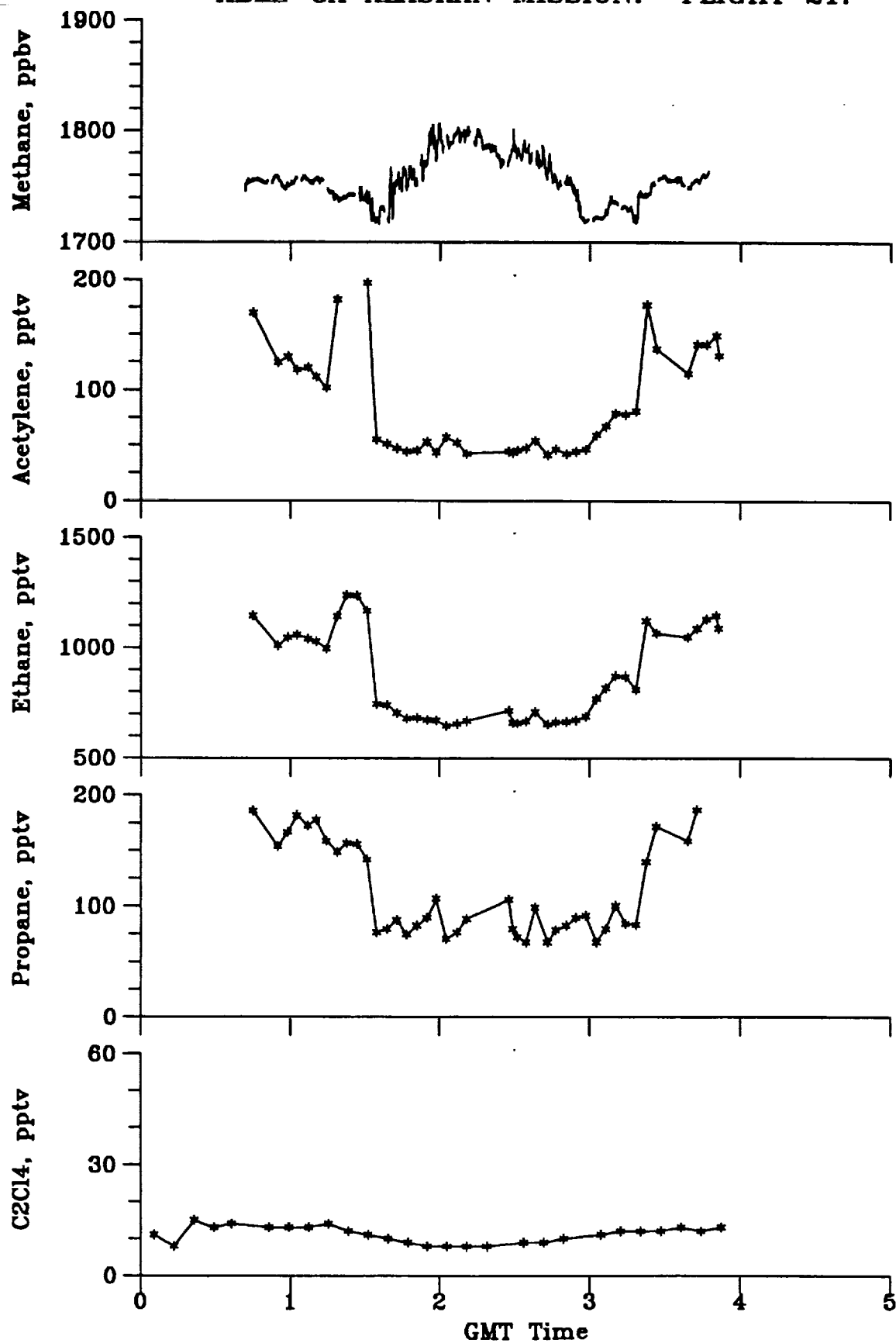
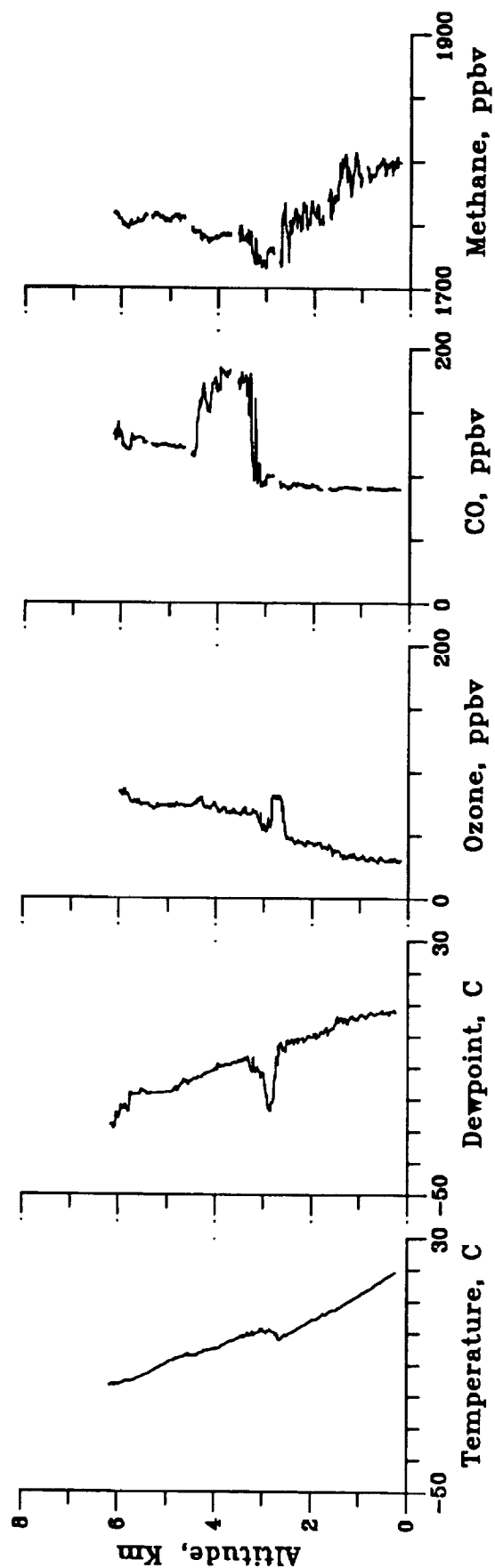


Figure A21.3

ABLE-3A ALASKAN MISSION: FLIGHT 21 PROFILE AT 0130 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 21 PROFILE AT 0300 GMT

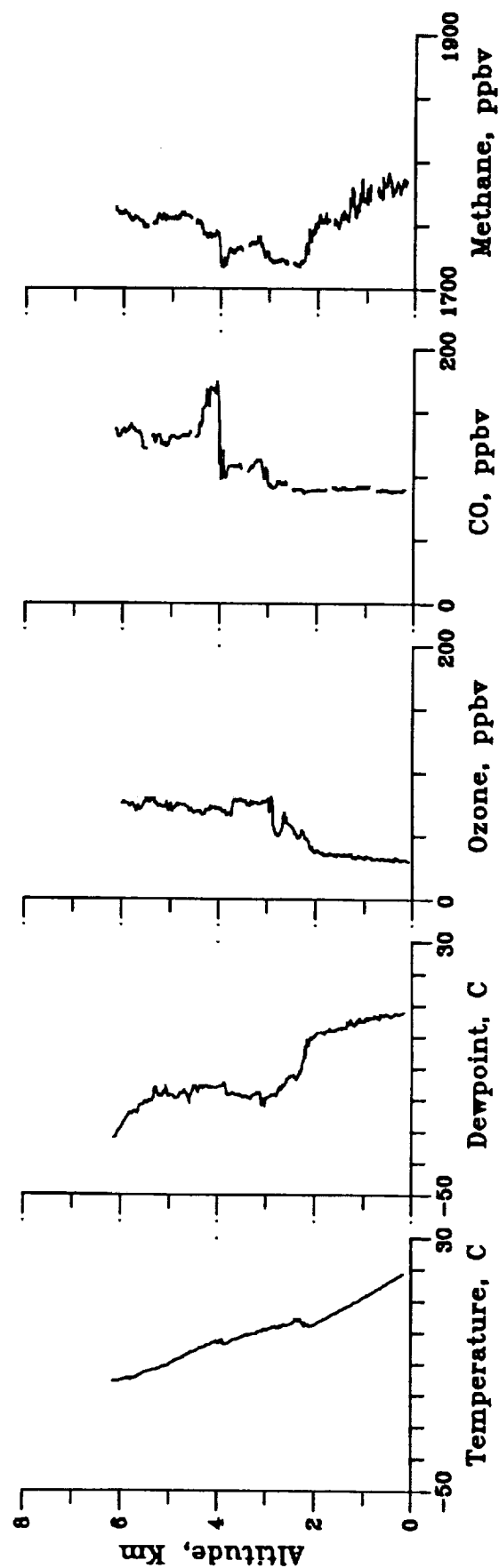


Figure A21.4

ABLE-3A ALASKAN MISSION: FLIGHT 22.

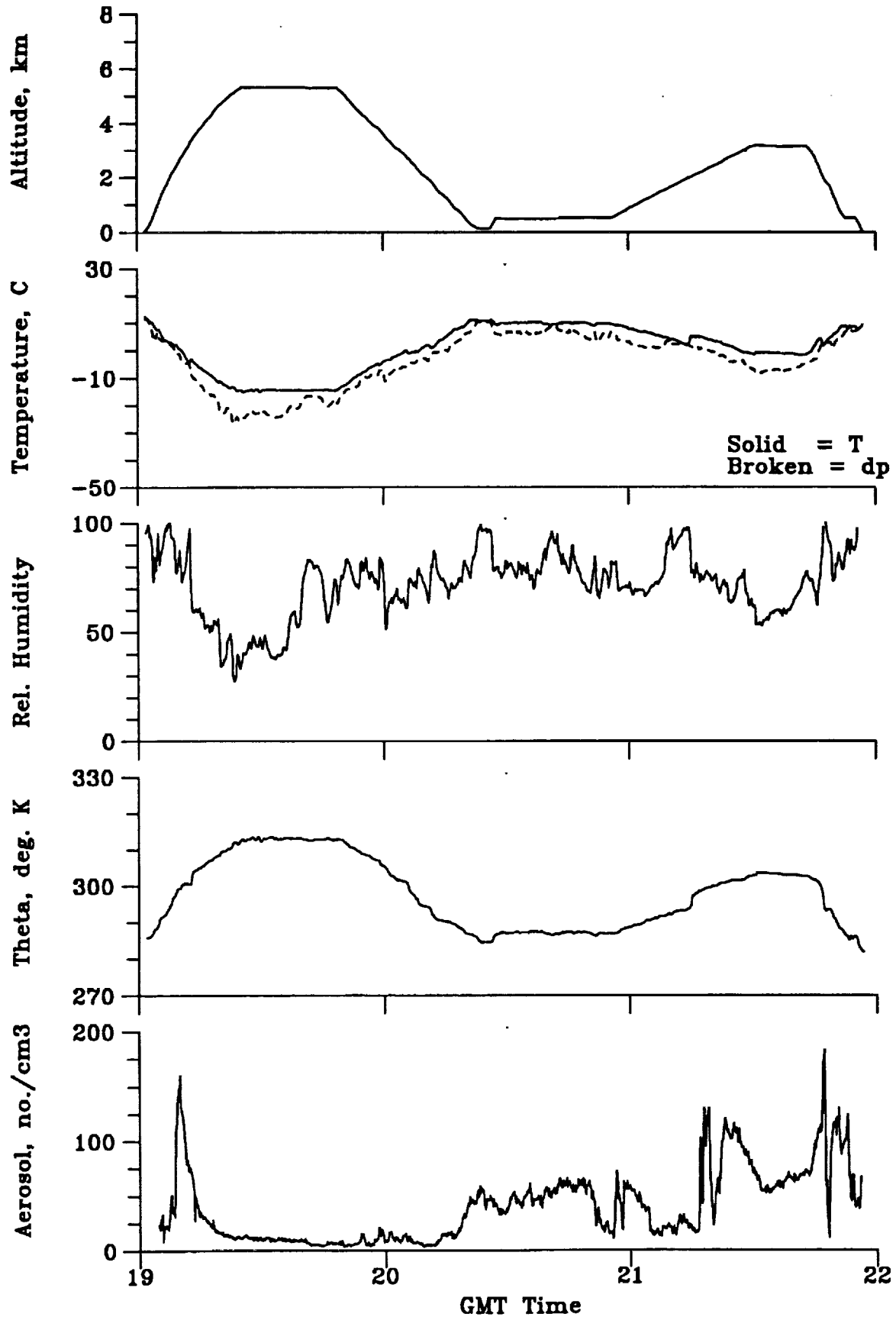


Figure A22.1



# ABLE-3A ALASKAN MISSION: FLIGHT 22.

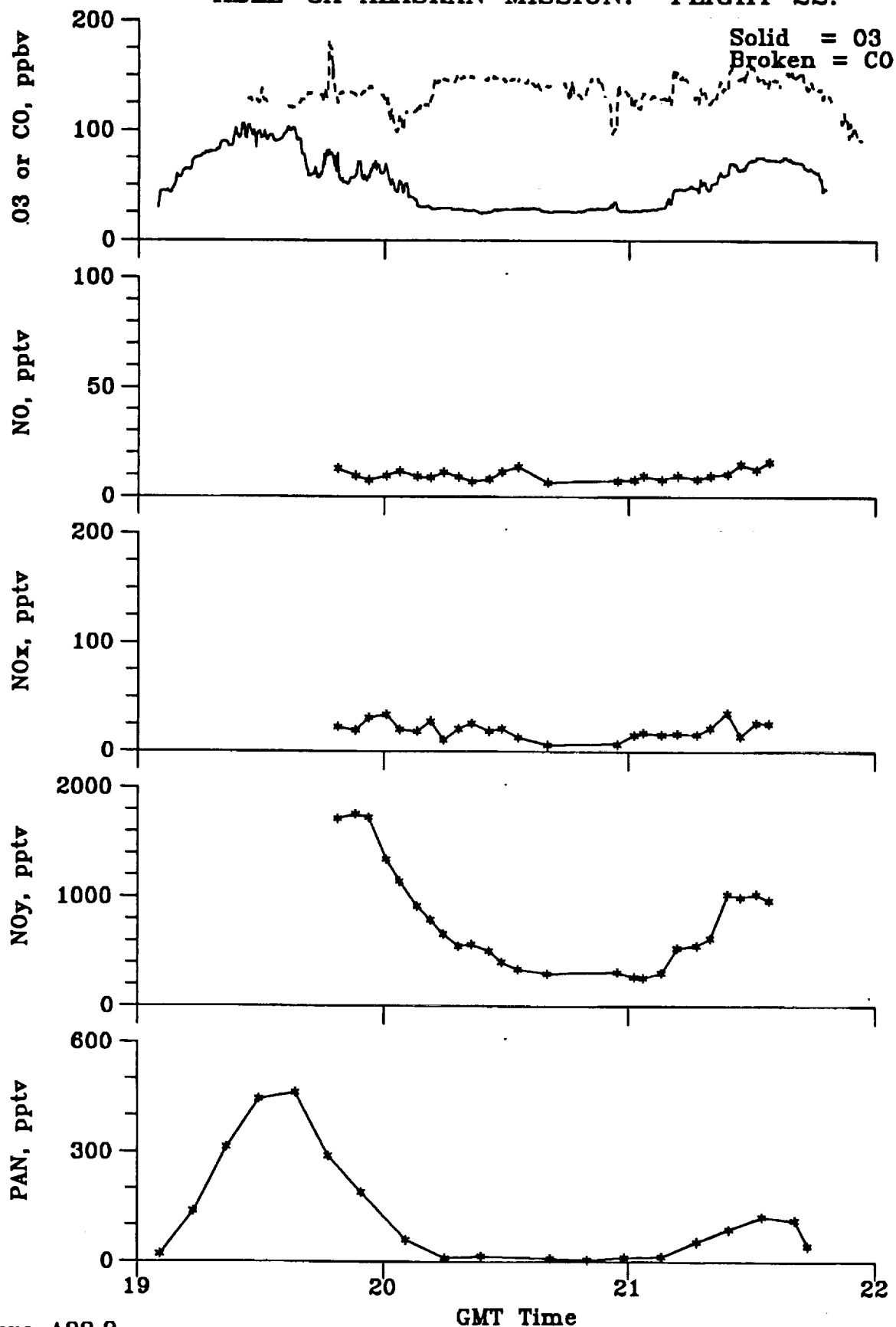


Figure A22.2

# ABLE-3A ALASKAN MISSION: FLIGHT 22.

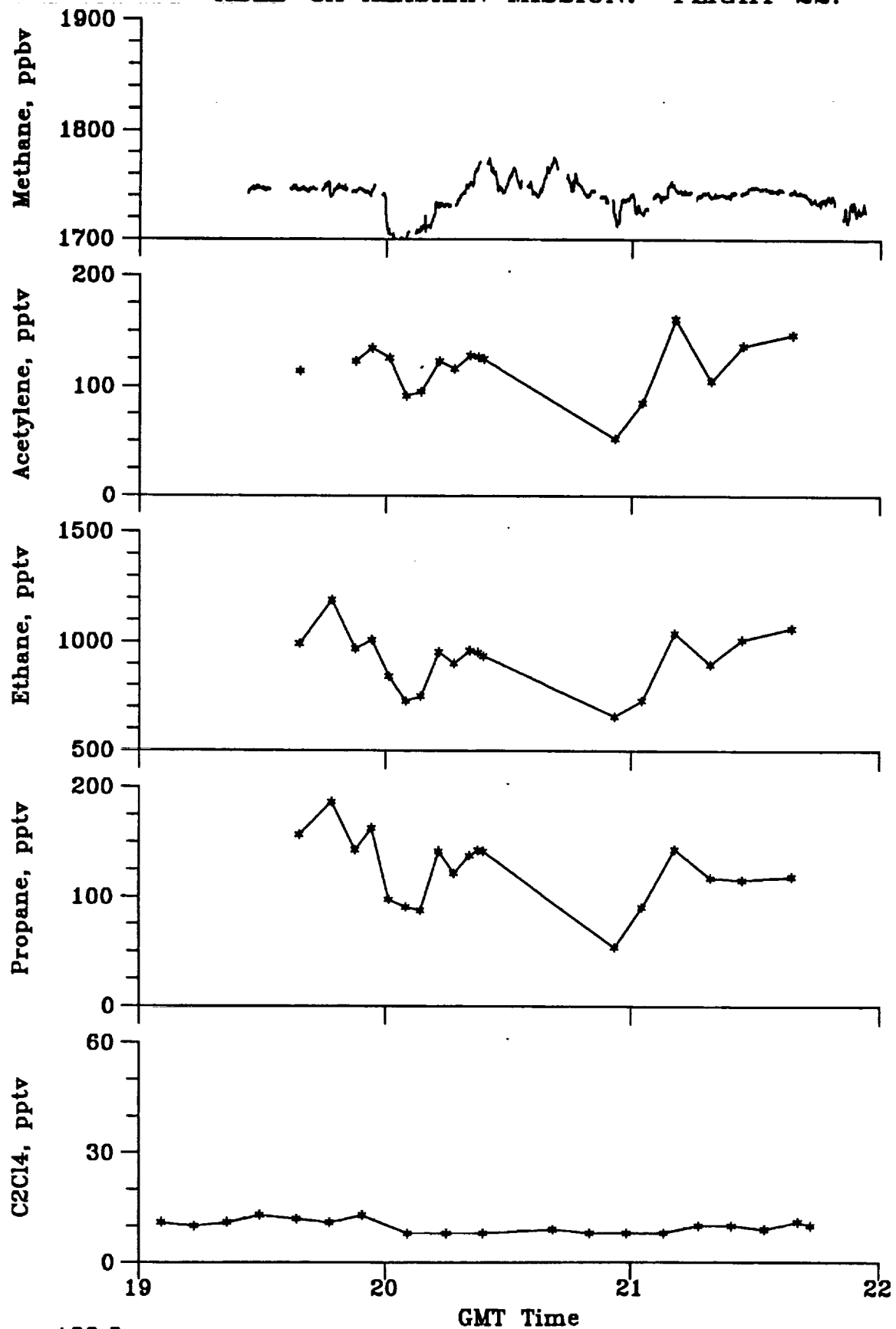


Figure A22.3

ABLE-3A ALASKAN MISSION: FLIGHT 22 PROFILE AT 2000 GMT

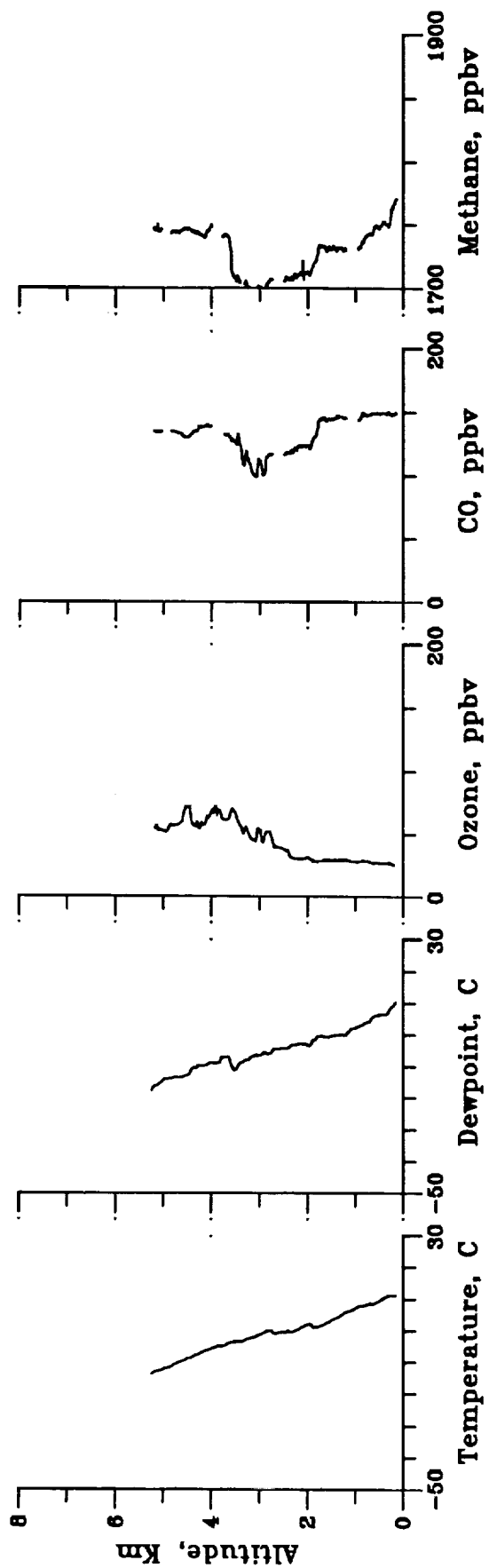


Figure A22.4

ABLE-3A ALASKAN MISSION: FLIGHT 23.

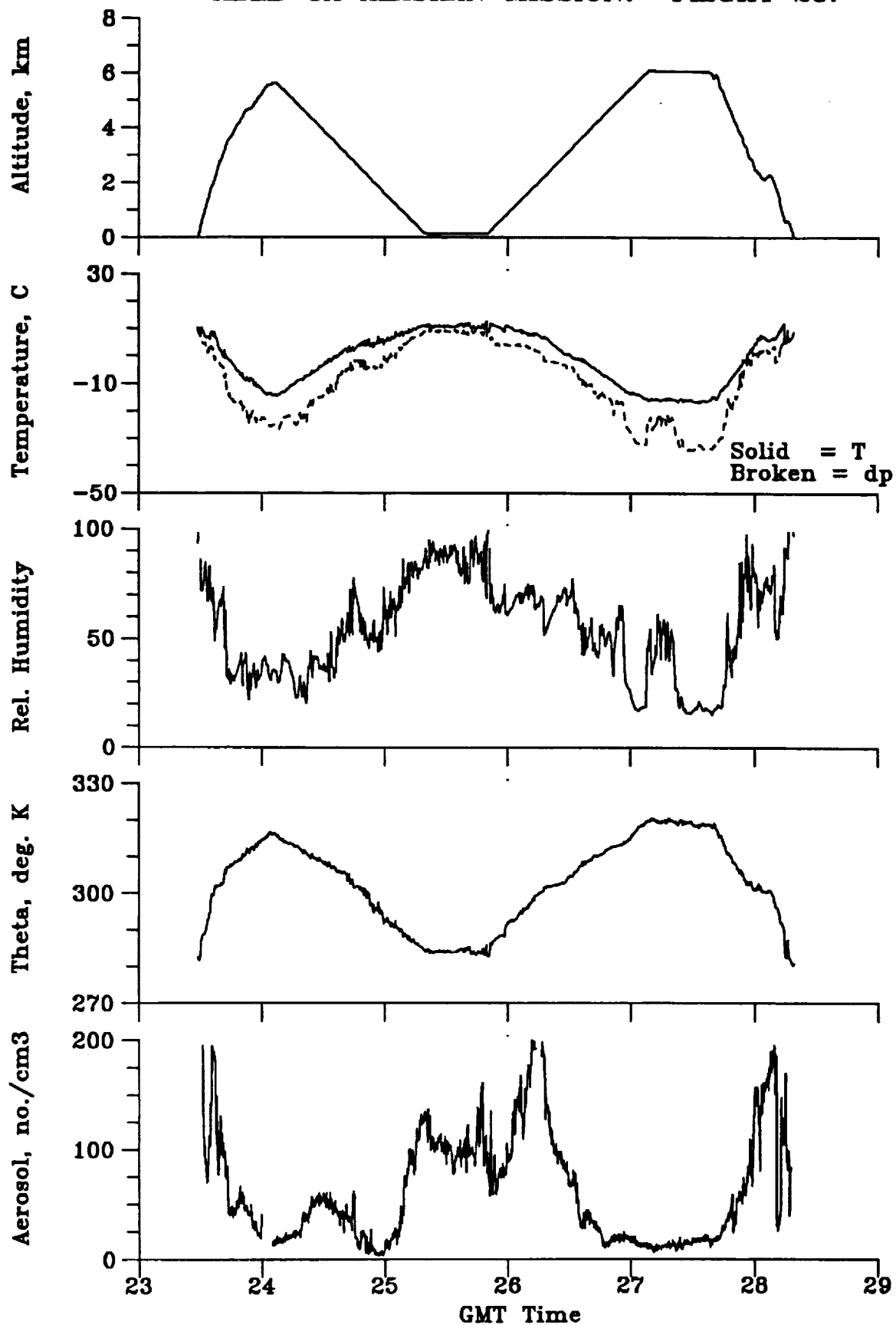


Figure A23.1

# ABLE-3A ALASKAN MISSION: FLIGHT 23.

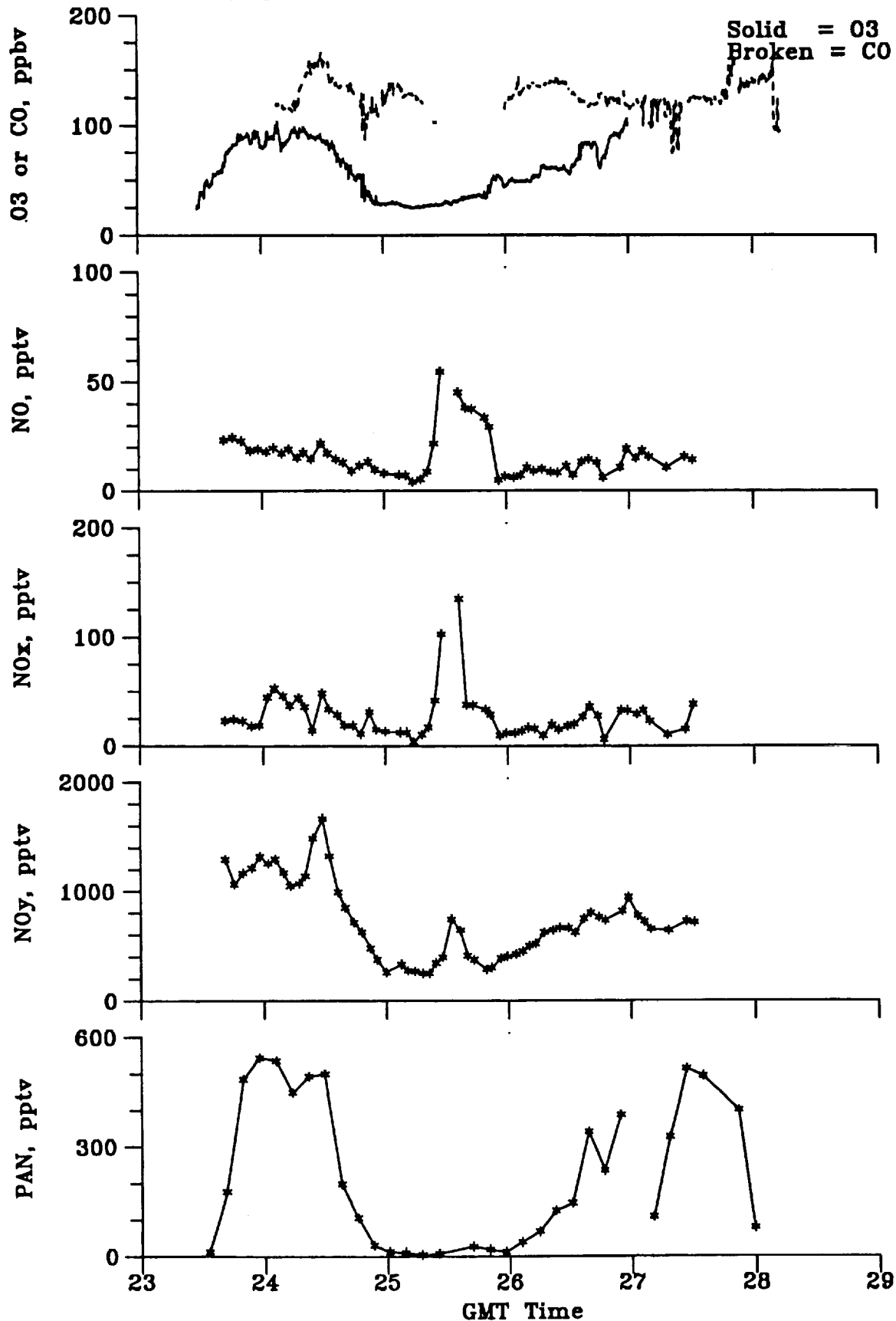


Figure A23.2

# ABLE-3A ALASKAN MISSION: FLIGHT 23.

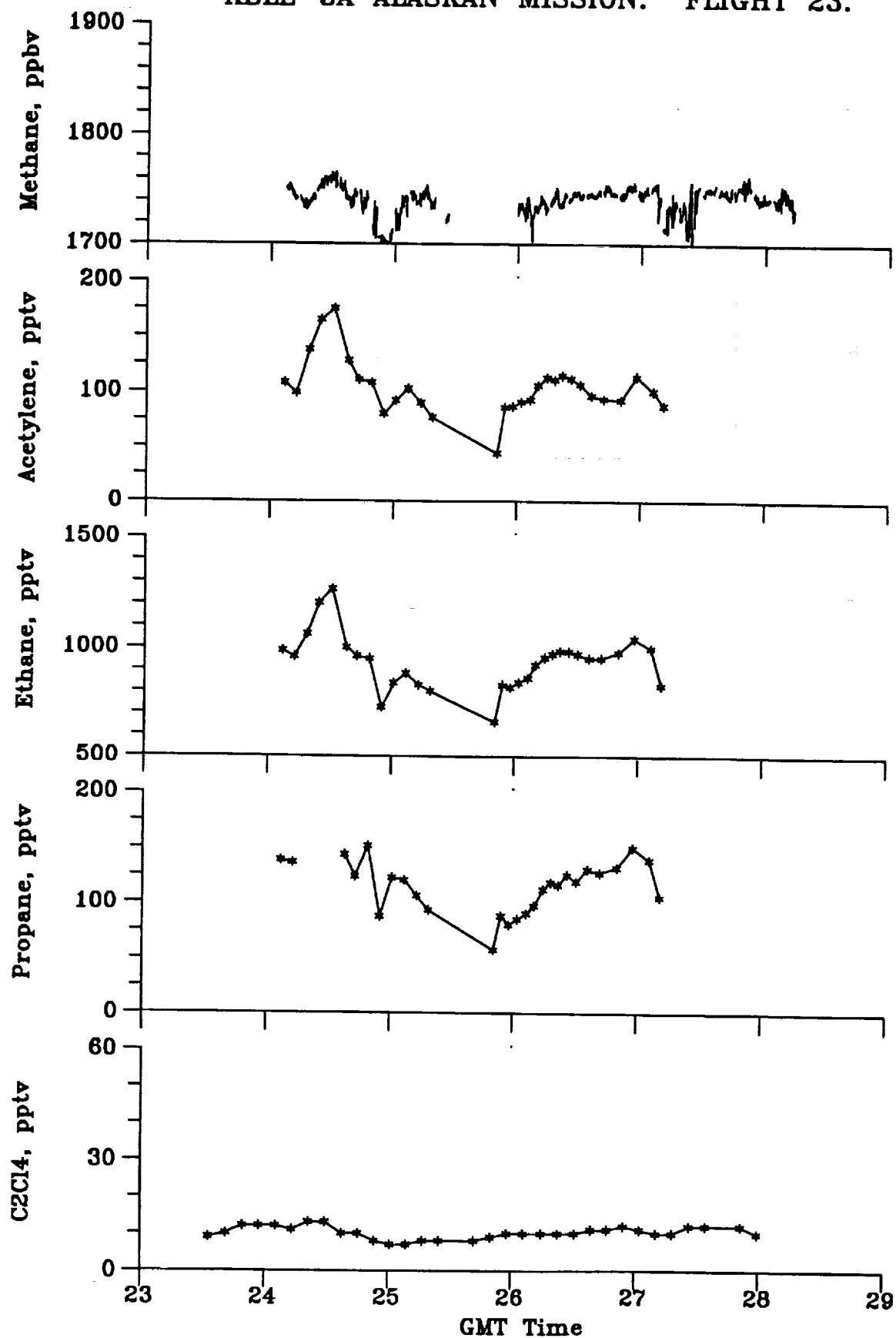
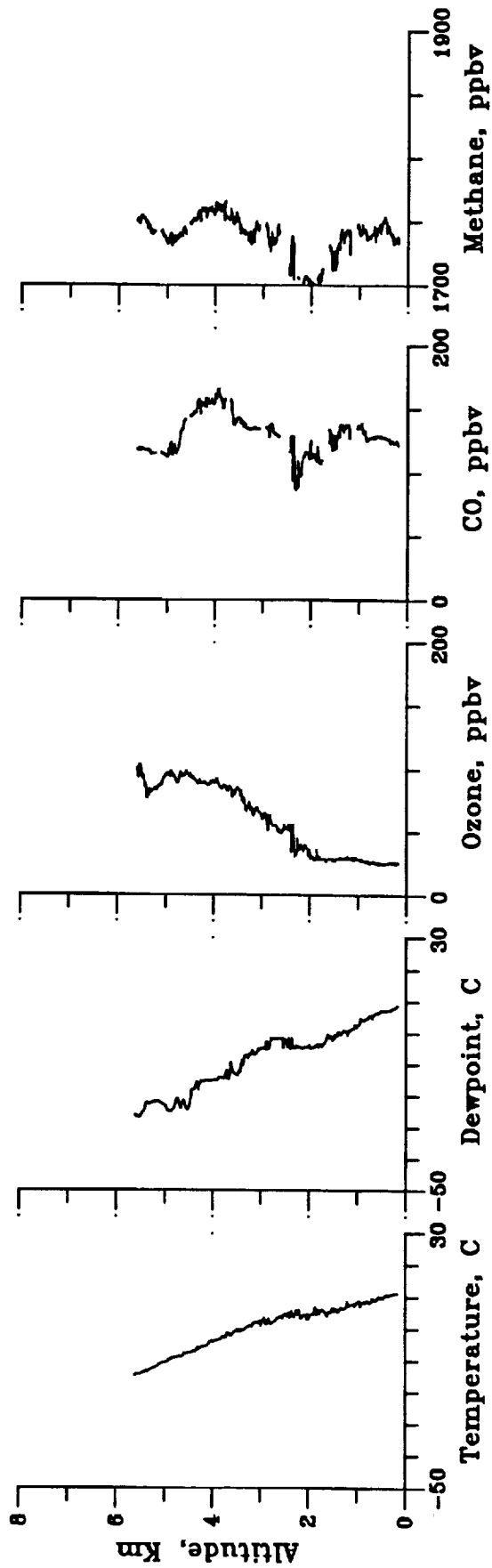


Figure A23.3

ABLE-3A ALASKAN MISSION: FLIGHT 23 PROFILE AT 0045 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 23 PROFILE AT 0230 GMT

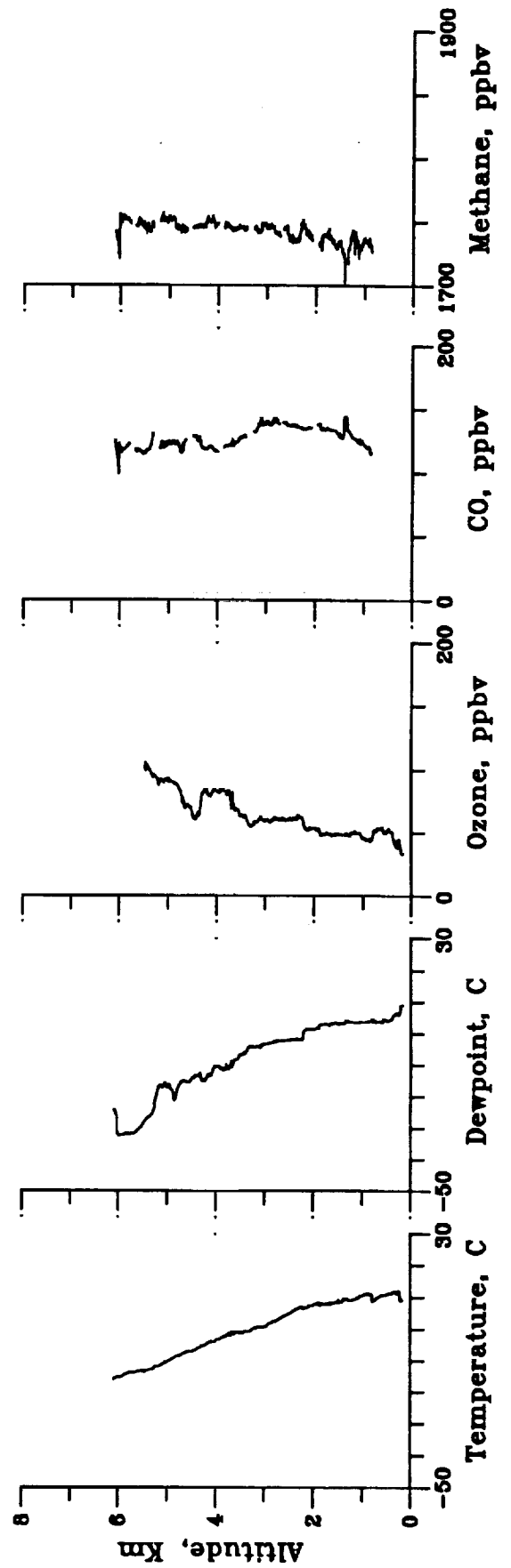


Figure A23.4

# ABLE-3A ALASKAN MISSION: FLIGHT 24.

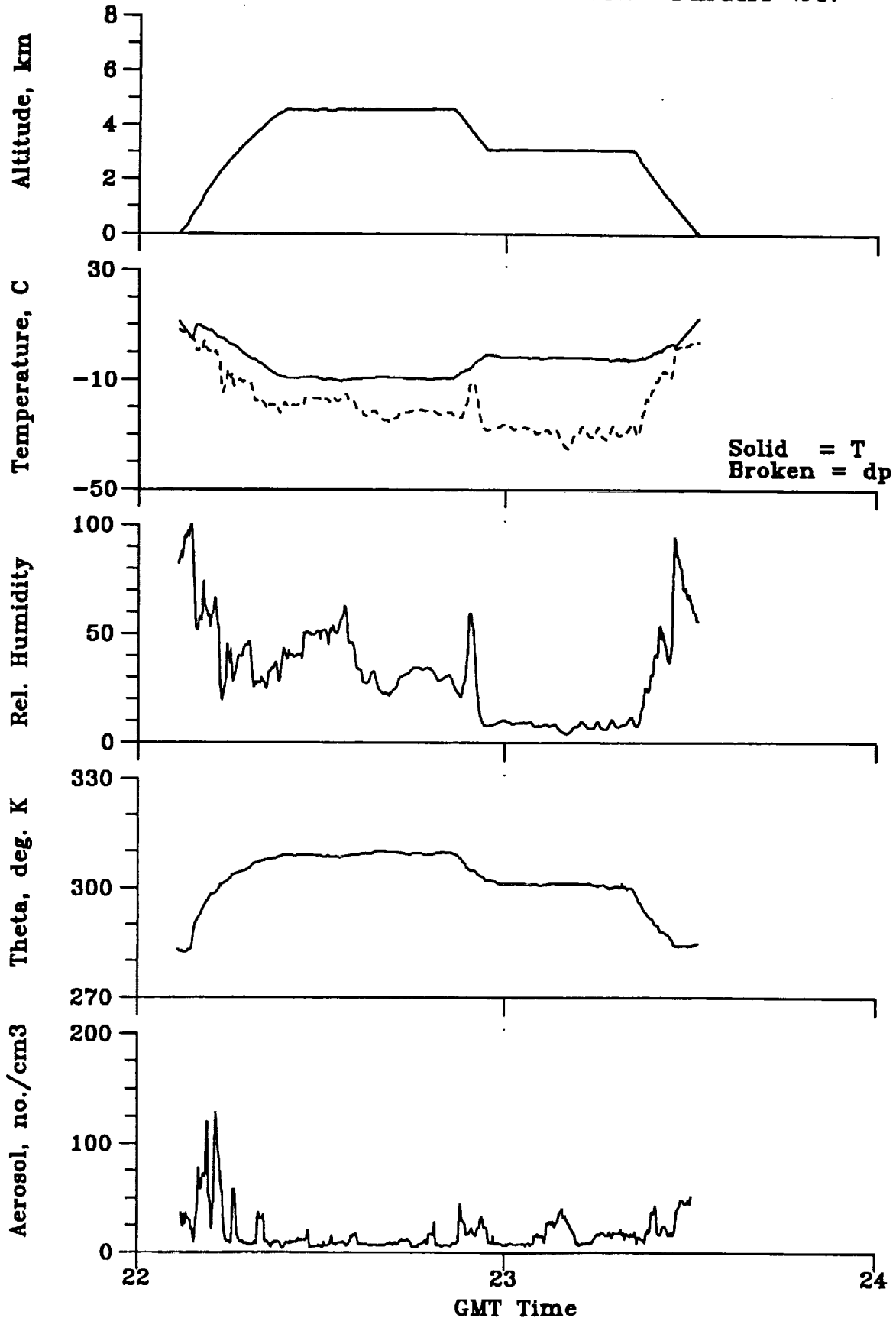


Figure A24.1



# ABLE-3A ALASKAN MISSION: FLIGHT 24.

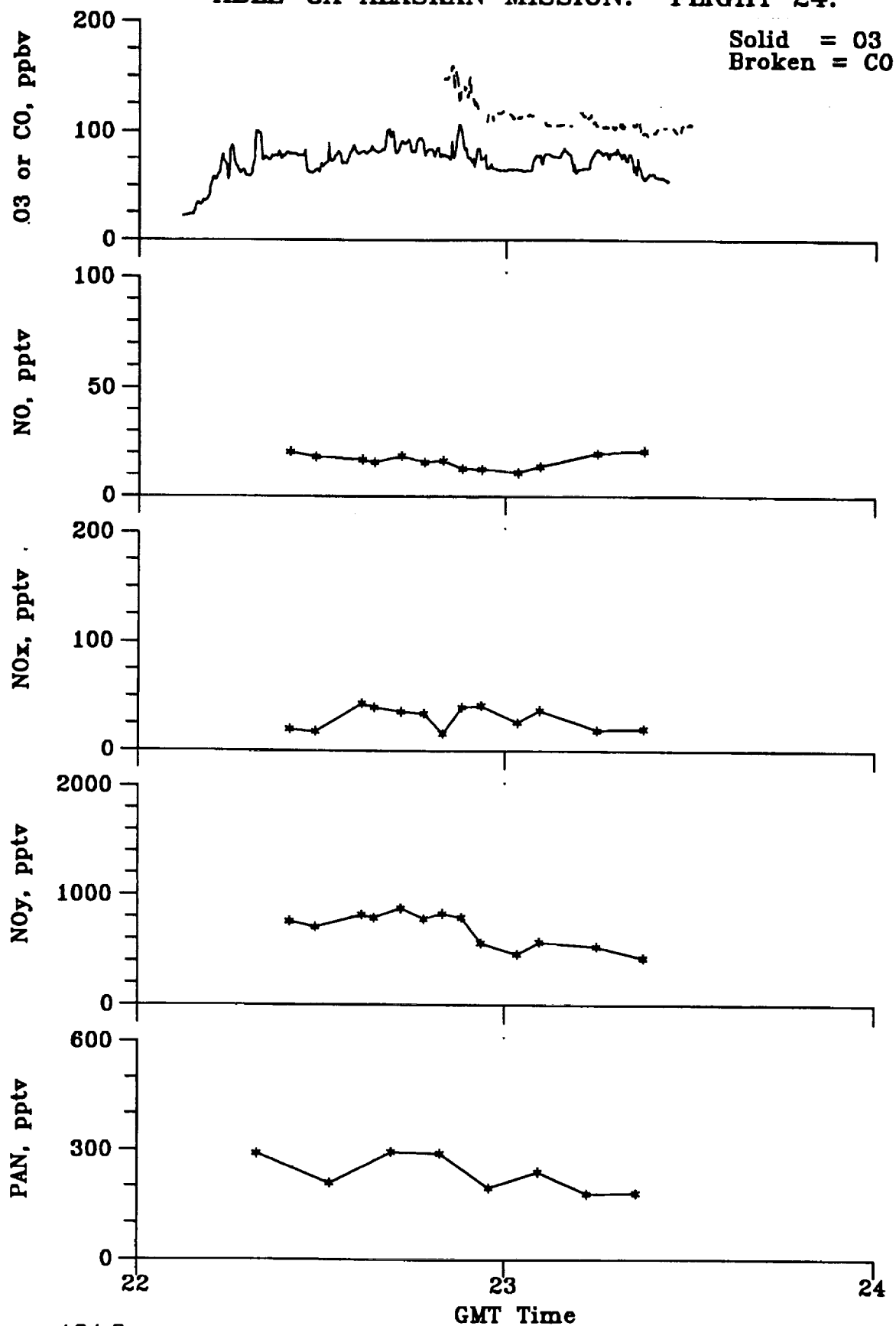


Figure A24.2

ABLE-3A ALASKAN MISSION: FLIGHT 24.

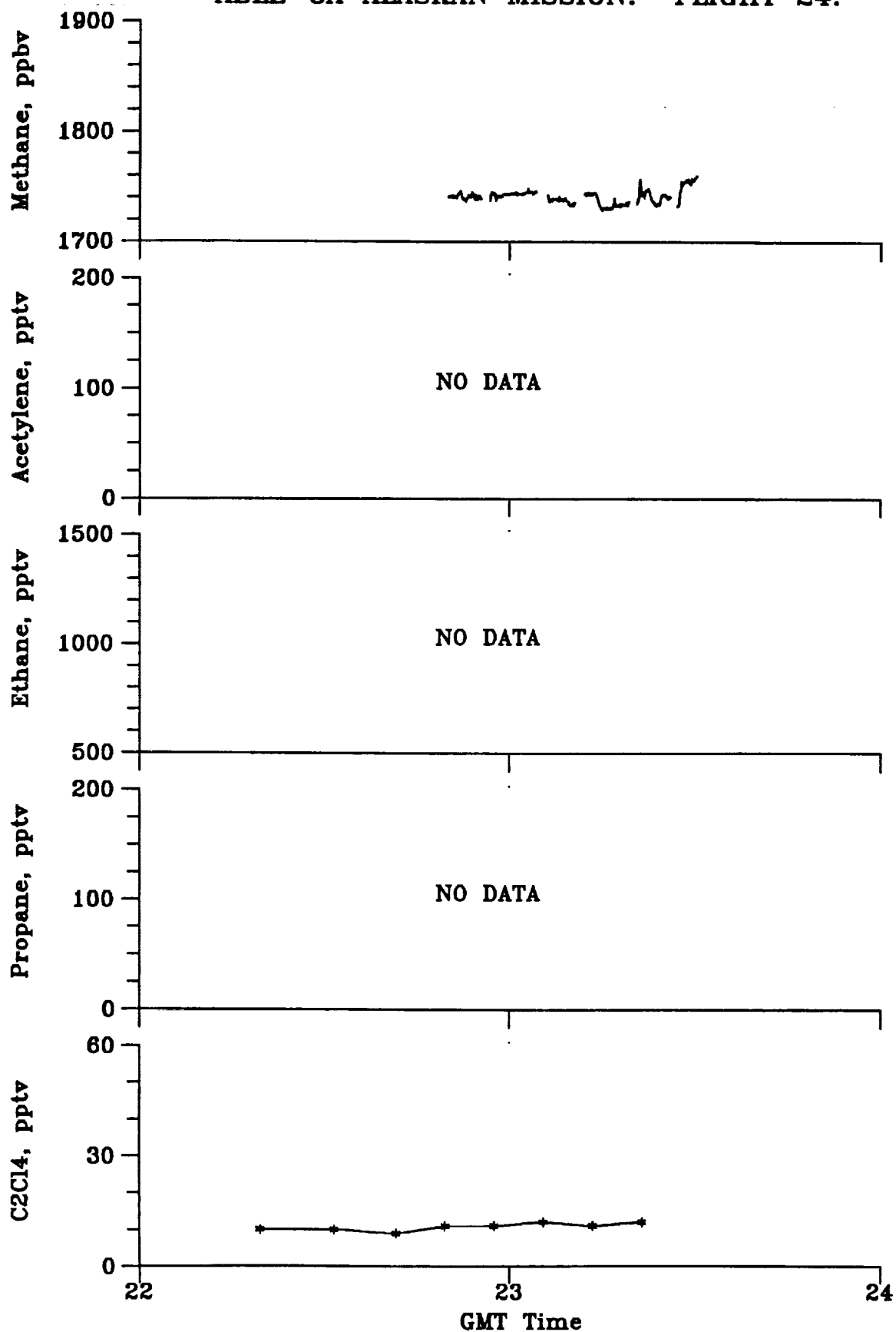
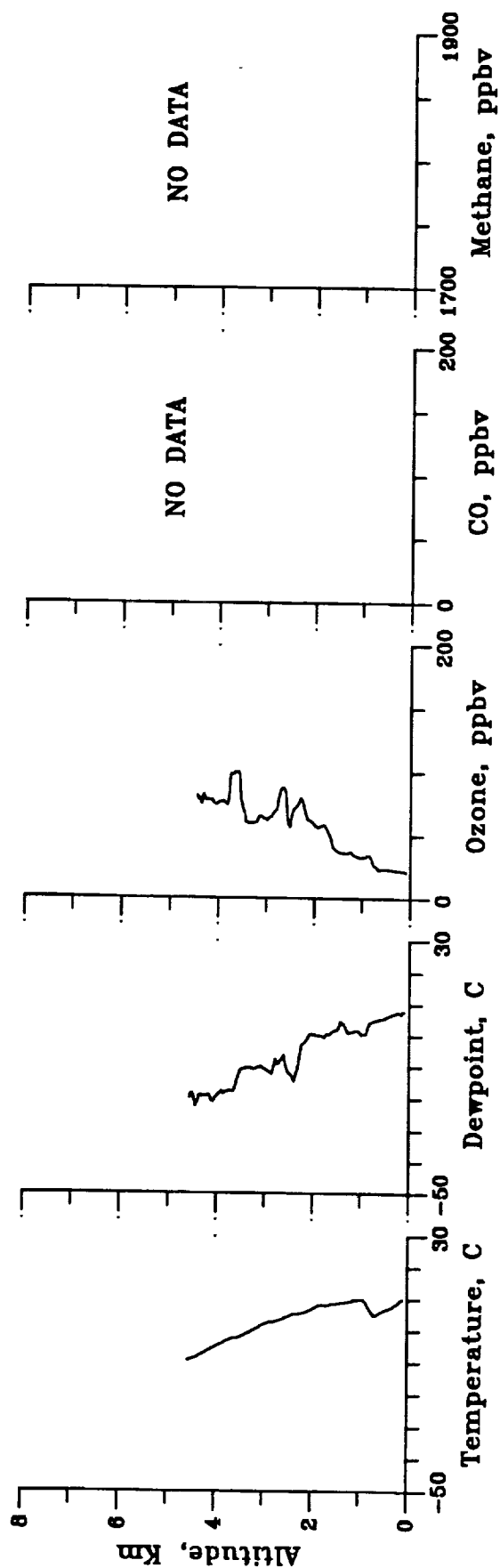


Figure A24.3

ABLE-3A ALASKAN MISSION: FLIGHT 24 PROFILE AT 2215 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 24 PROFILE AT 2330 GMT

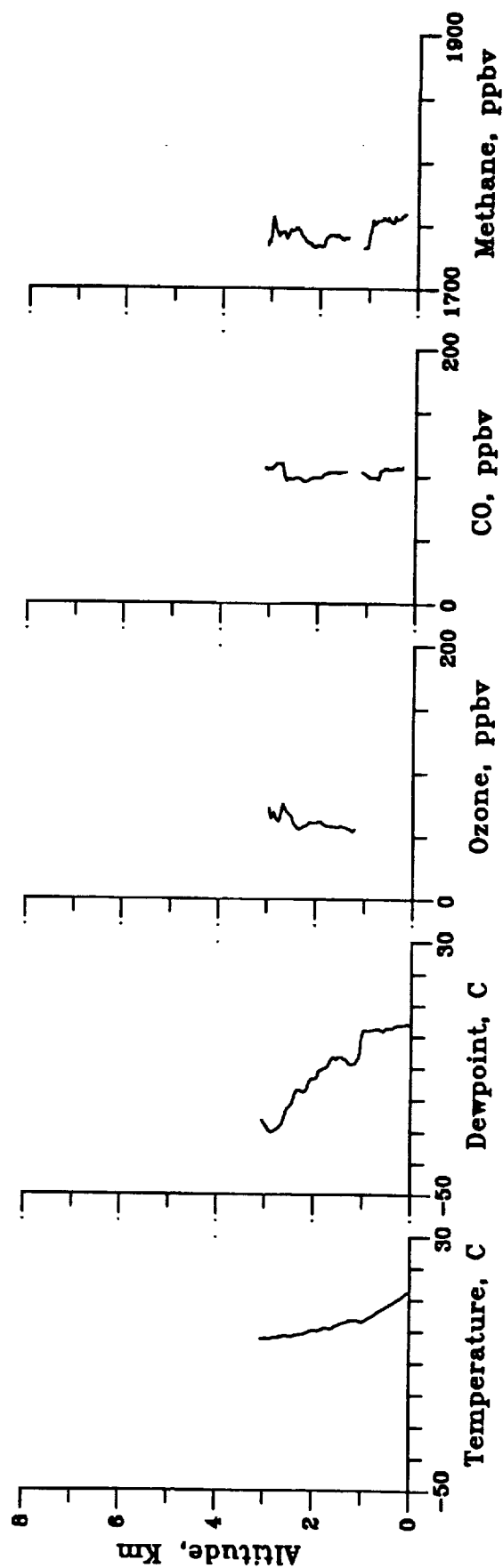


Figure A24.4

# ABLE-3A ALASKAN MISSION: FLIGHT 25.

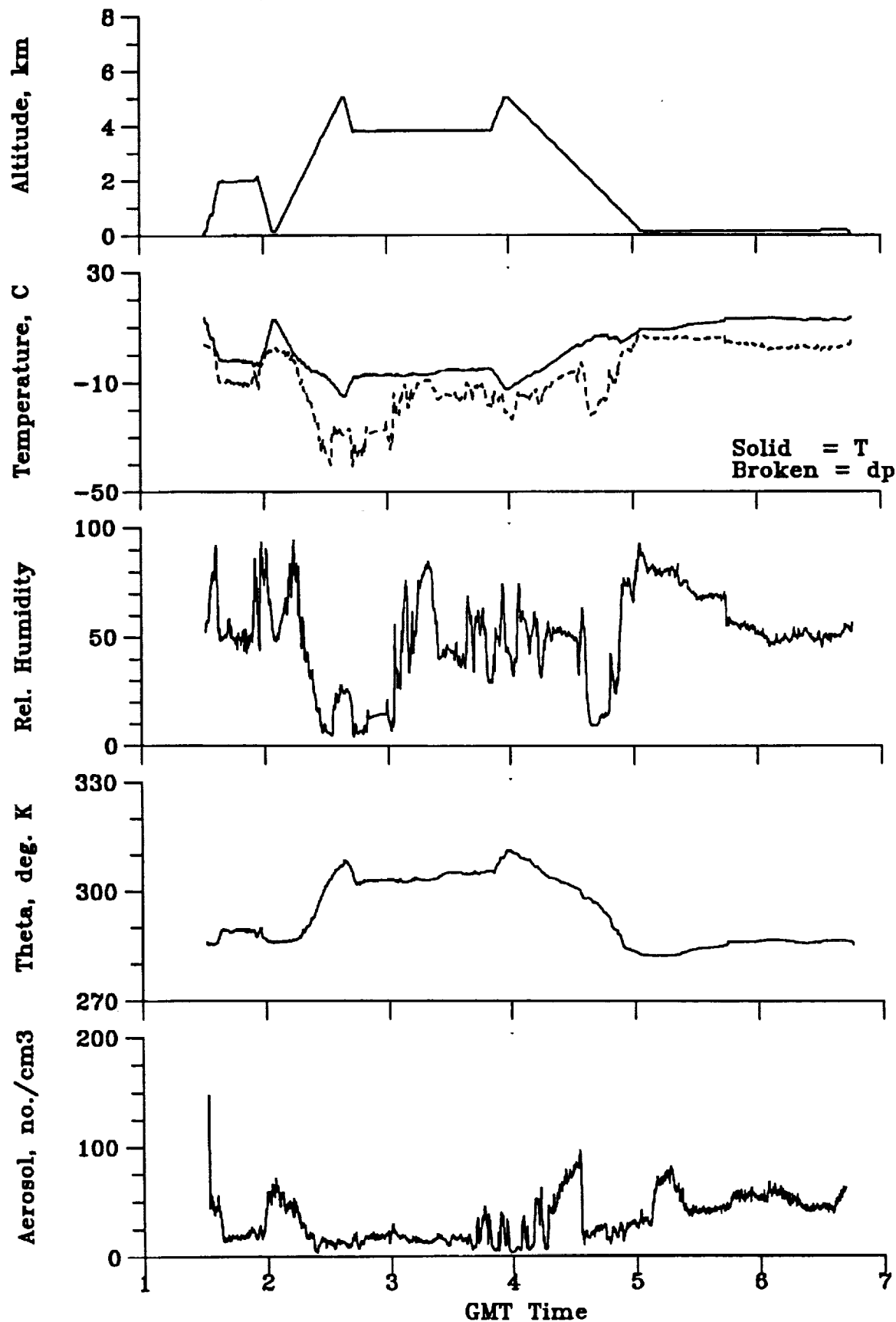


Figure A25.1

ABLE-3A ALASKAN MISSION: FLIGHT 25.

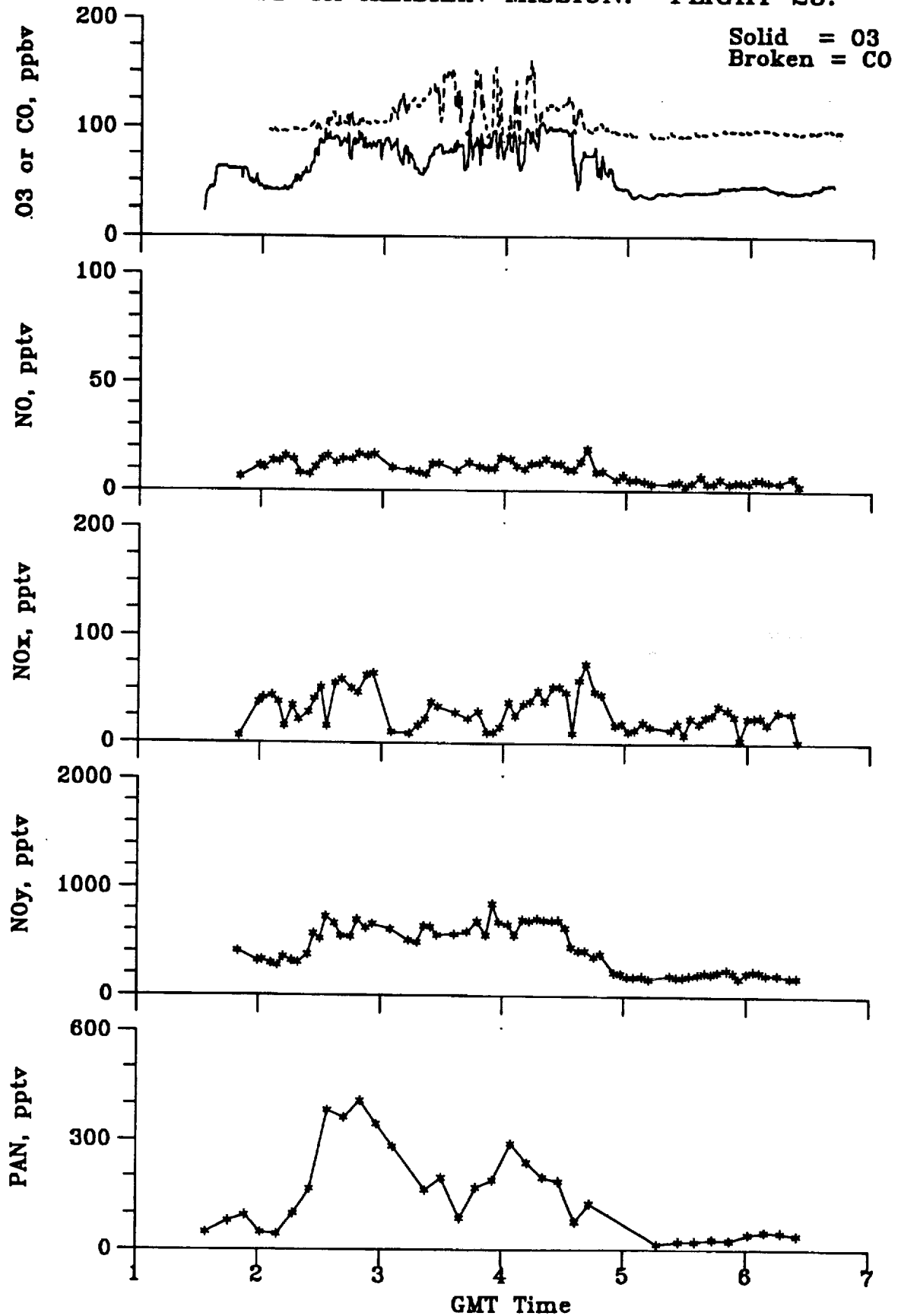


Figure A25.2

# ABLE-3A ALASKAN MISSION: FLIGHT 25.

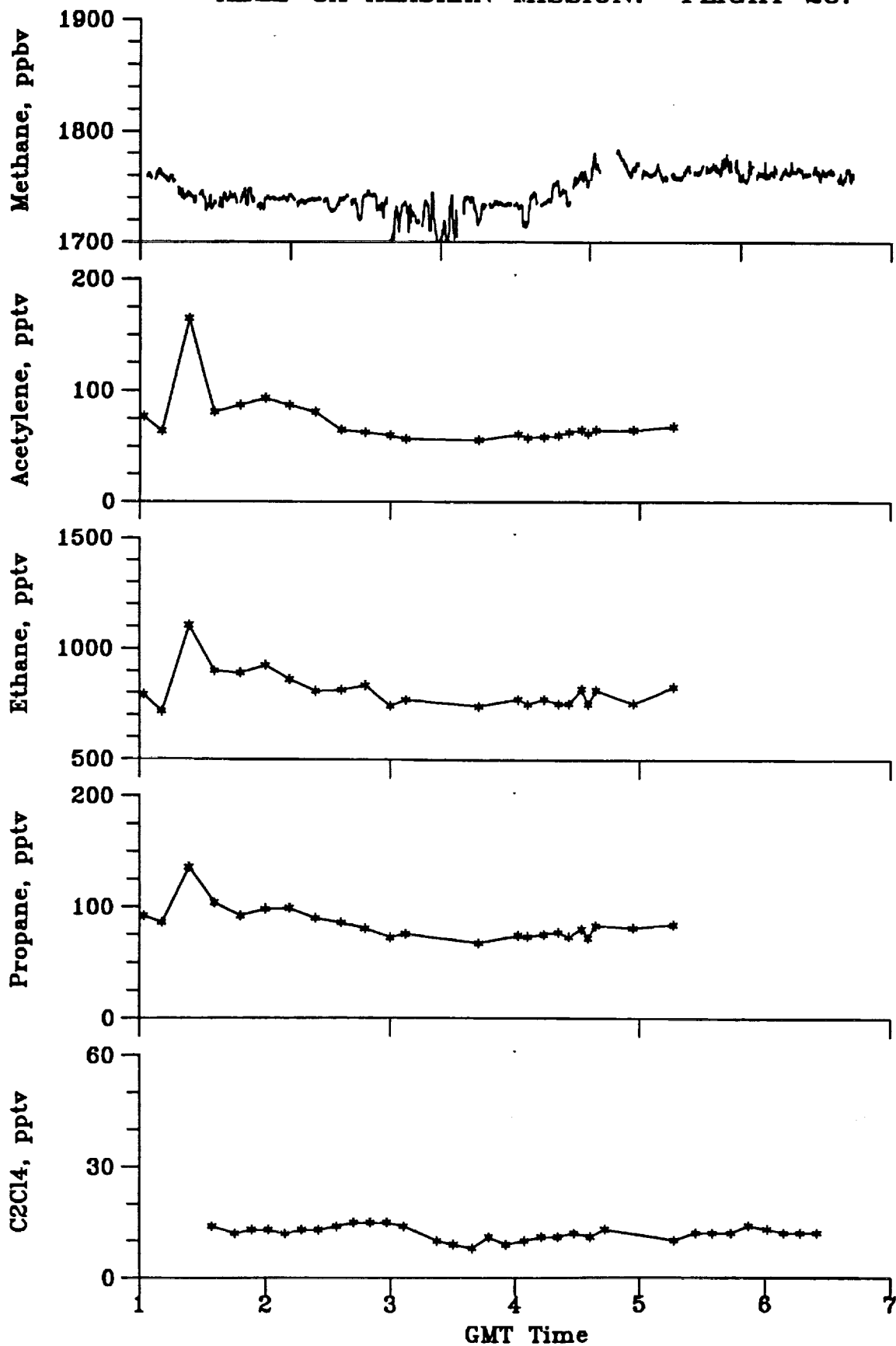
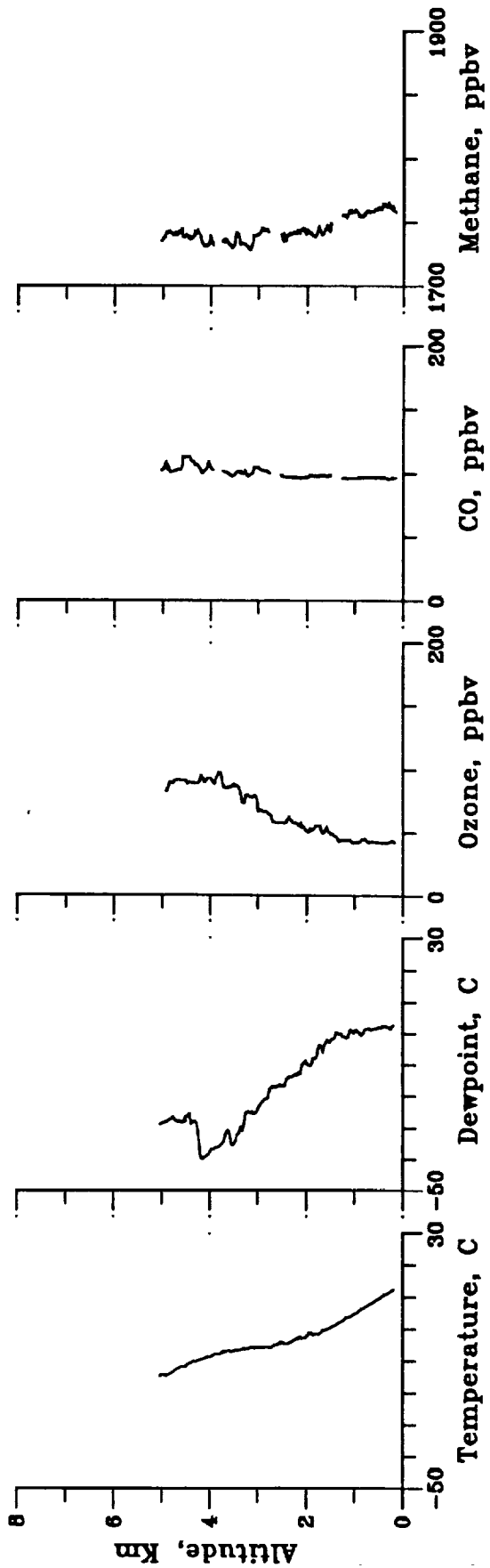


Figure A25.3

ABLE-3A ALASKAN MISSION: FLIGHT 25 PROFILE AT 0230 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 25 PROFILE AT 0430 GMT

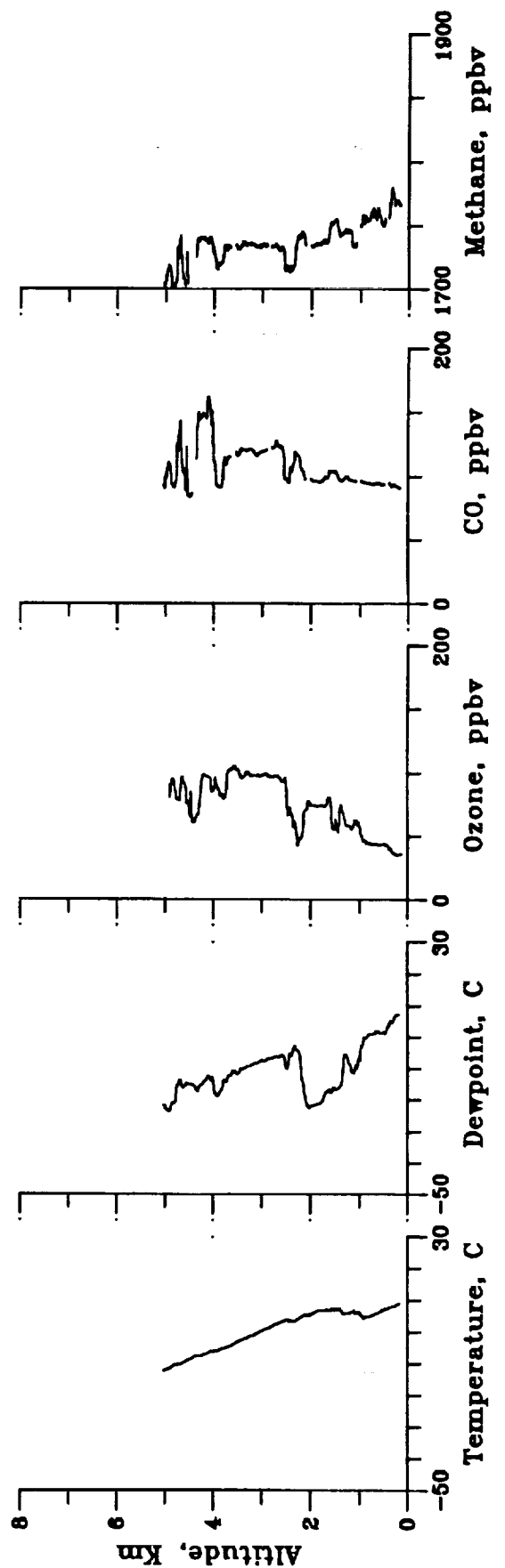


Figure A25.4

# ABLE-3A ALASKAN MISSION: FLIGHT 26.

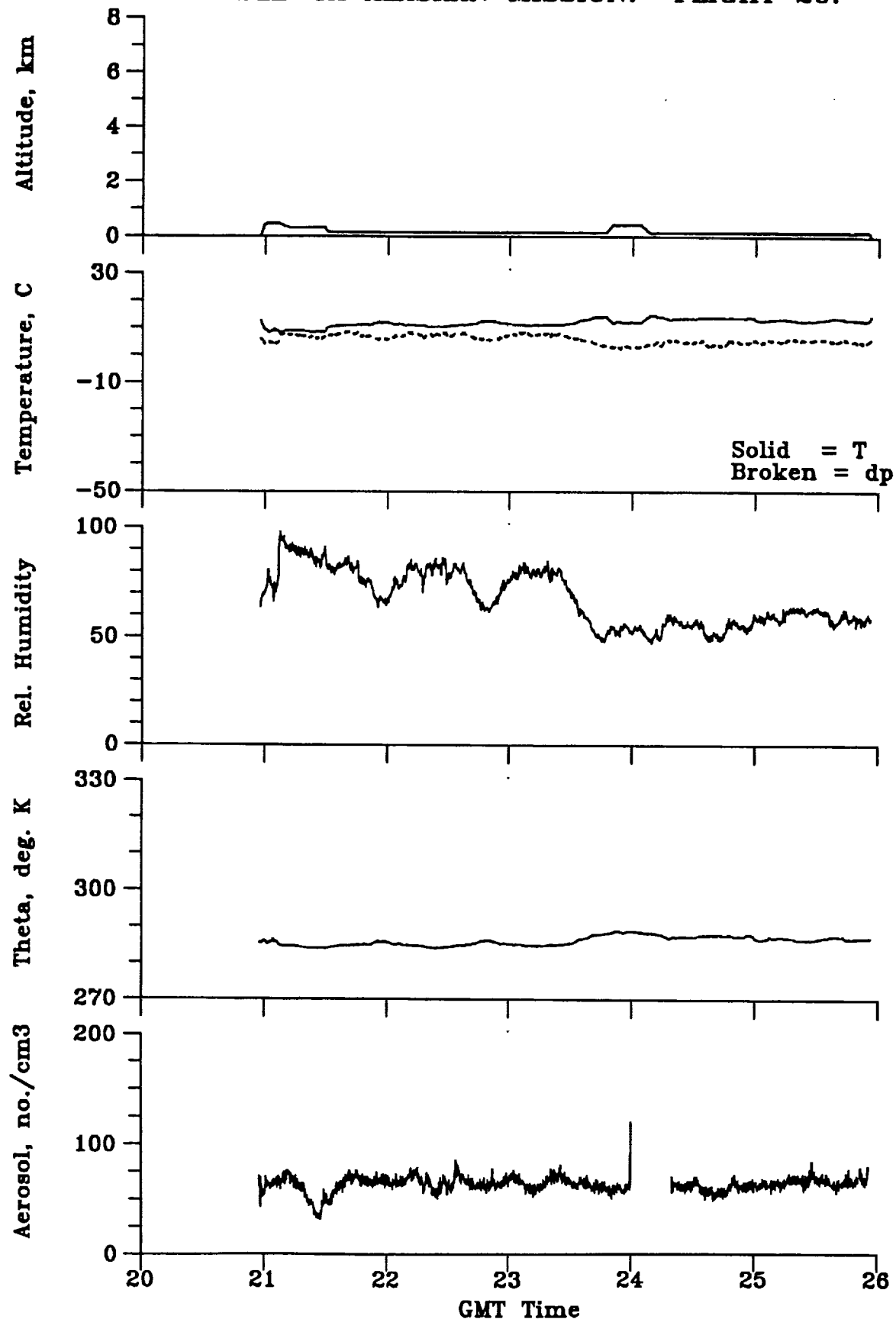


Figure A26.1



# ABLE-3A ALASKAN MISSION: FLIGHT 26.

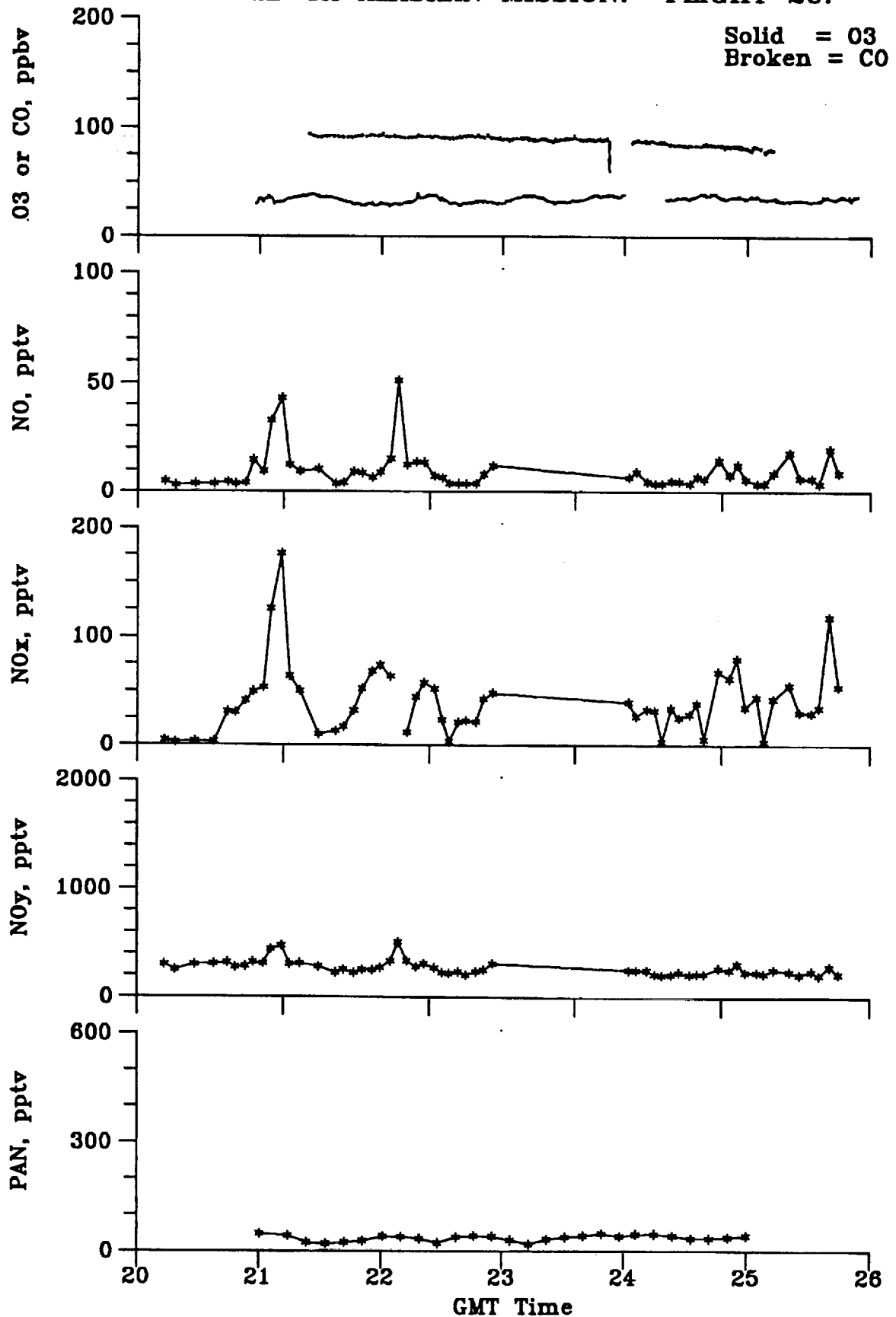


Figure A26.2

ABLE-3A ALASKAN MISSION: FLIGHT 26.

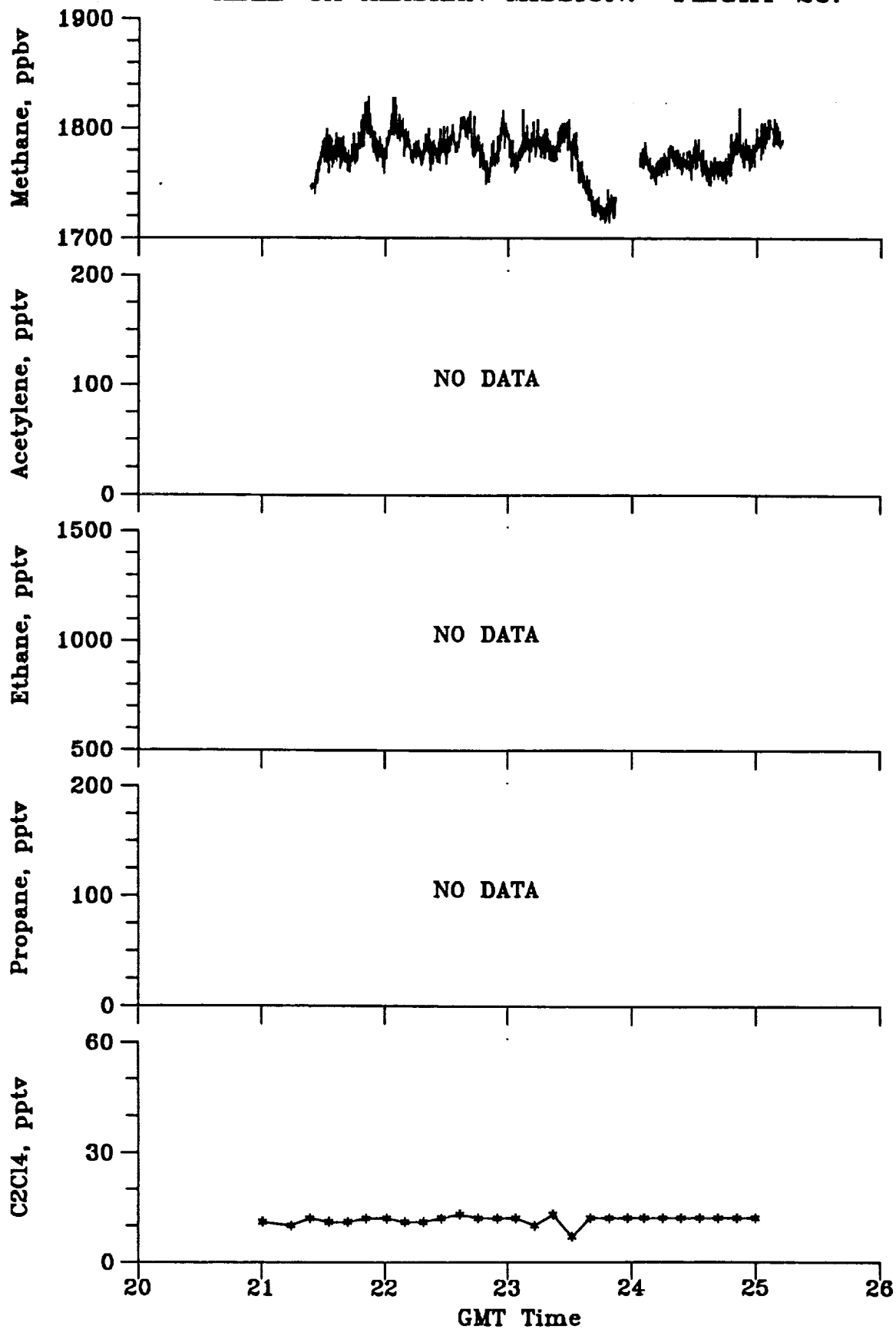


Figure A26.3

ABLE-3A ALASKAN MISSION: FLIGHT 27.

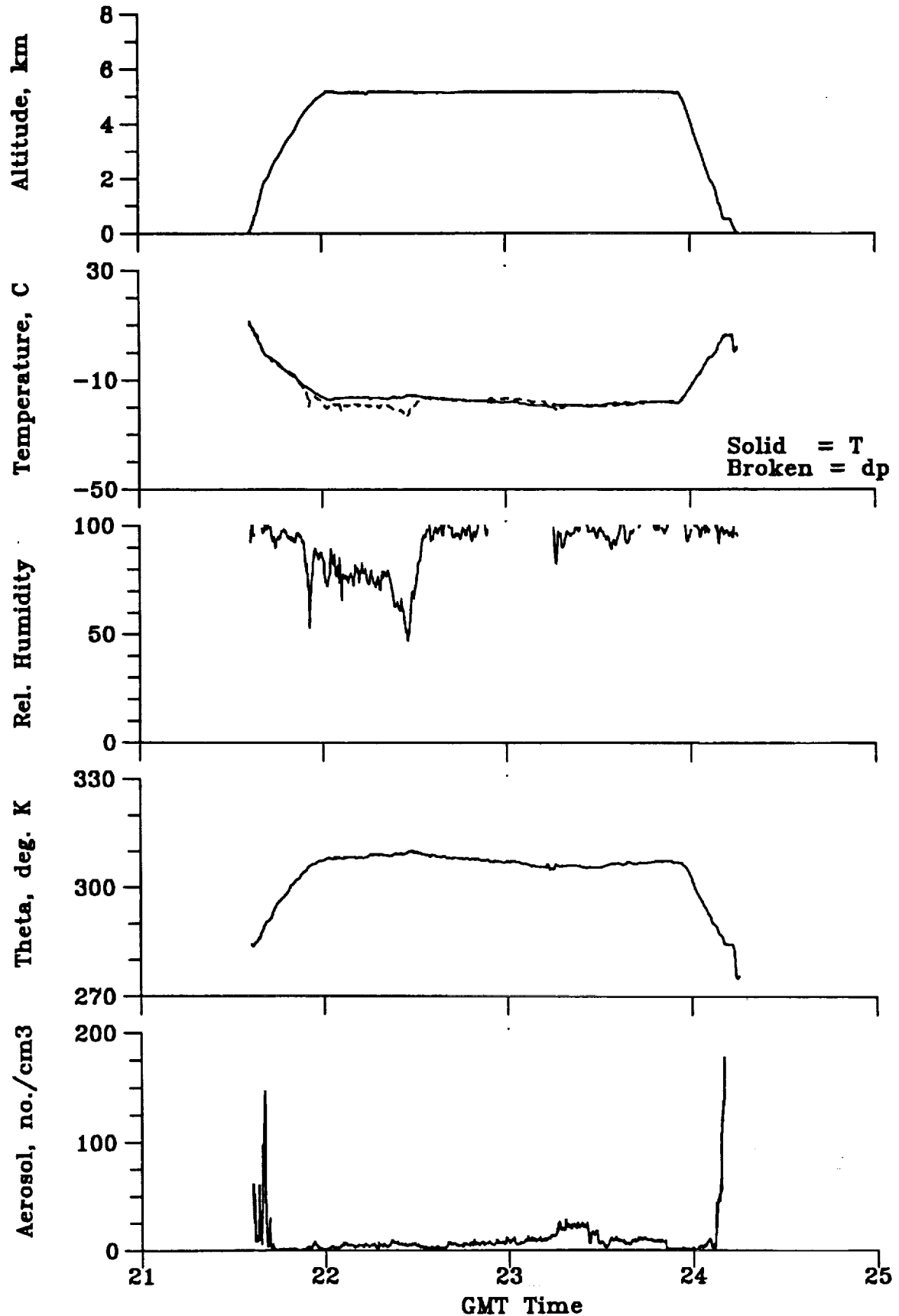


Figure A27.1

# ABLE-3A ALASKAN MISSION: FLIGHT 27.

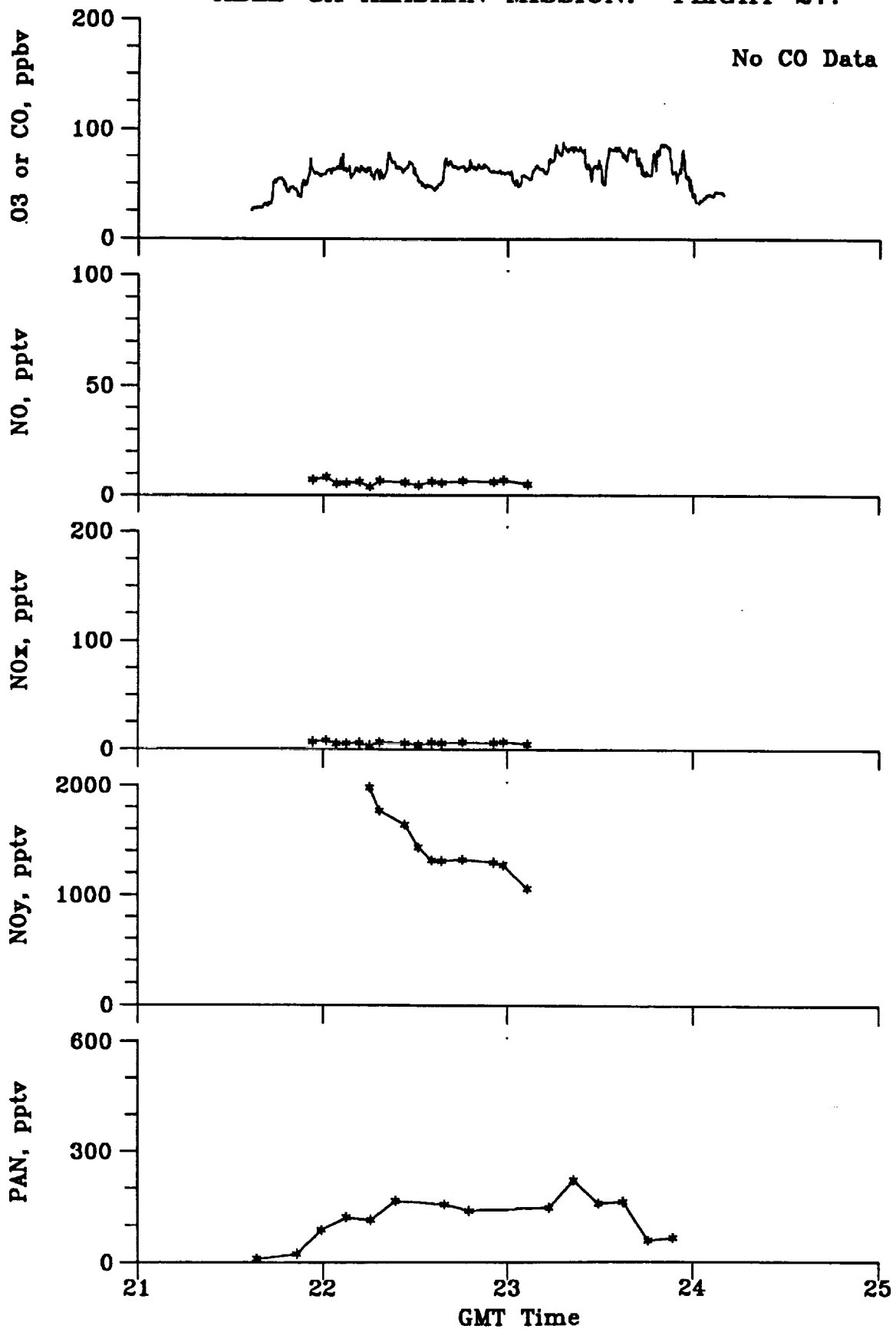


Figure A27.2

ABLE-3A ALASKAN MISSION: FLIGHT 27.

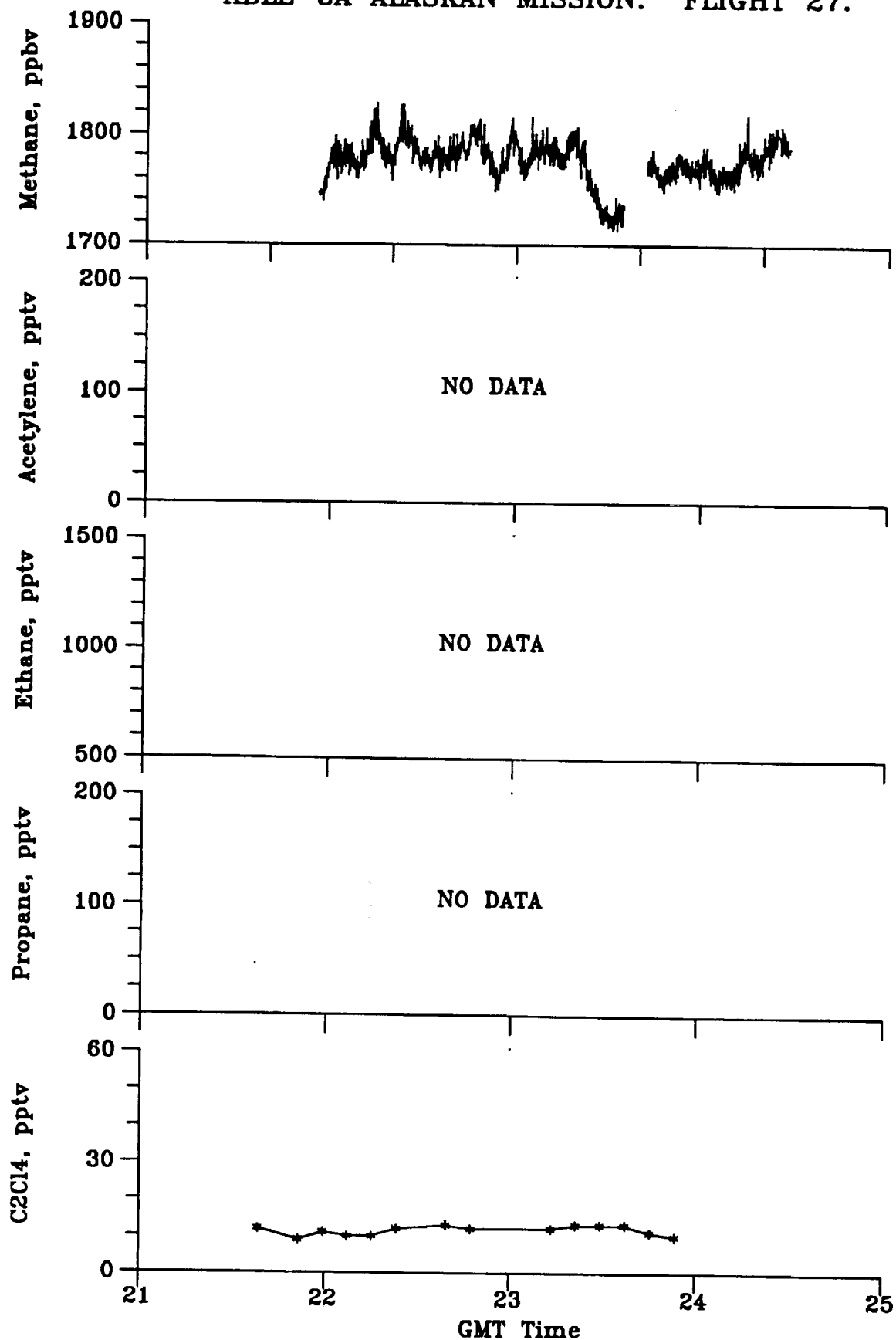
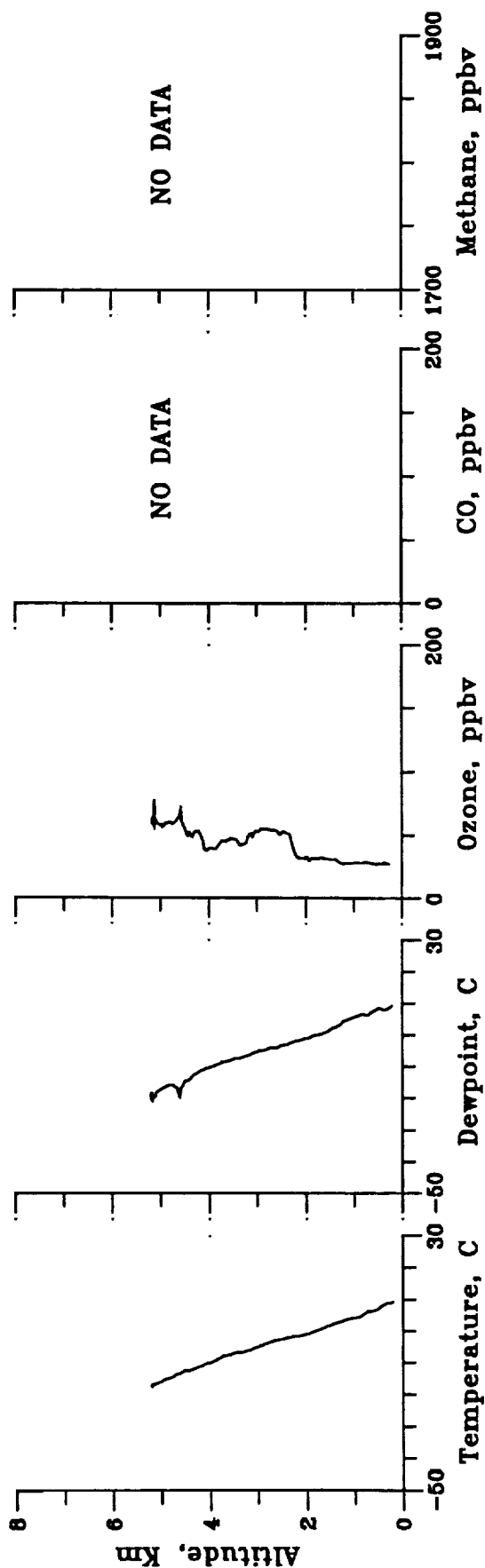


Figure A27.3

ABLE-3A ALASKAN MISSION: FLIGHT 27 PROFILE AT 2145 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 27 PROFILE AT 0000 GMT

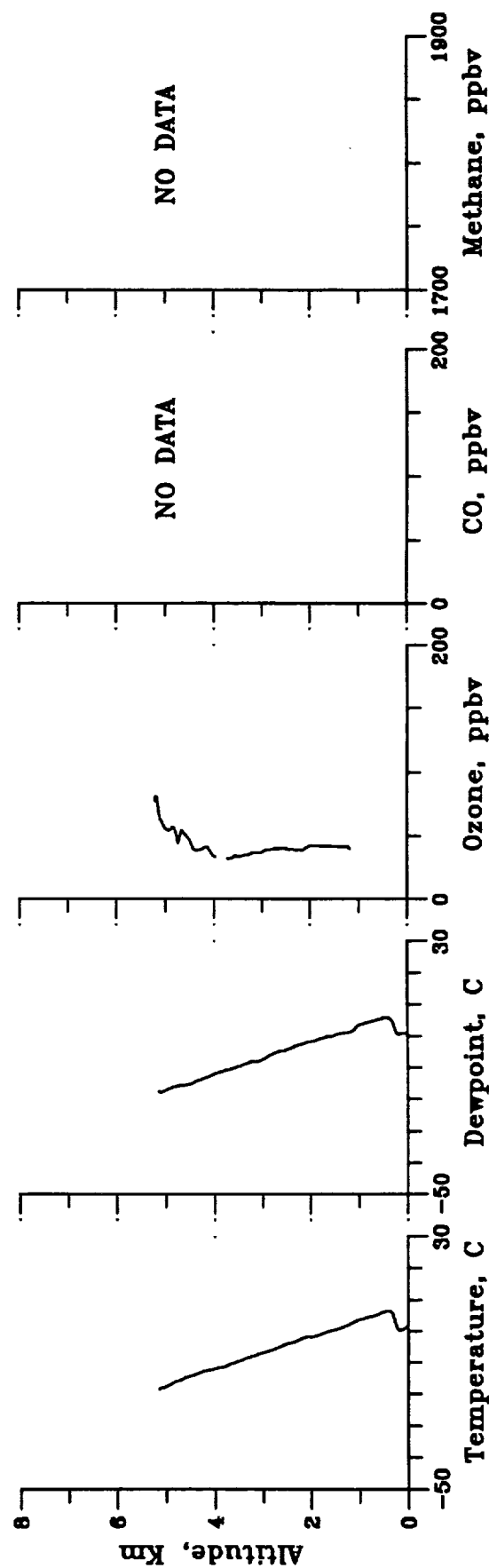


Figure A27.4

# ABLE-3A ALASKAN MISSION: FLIGHT 28.

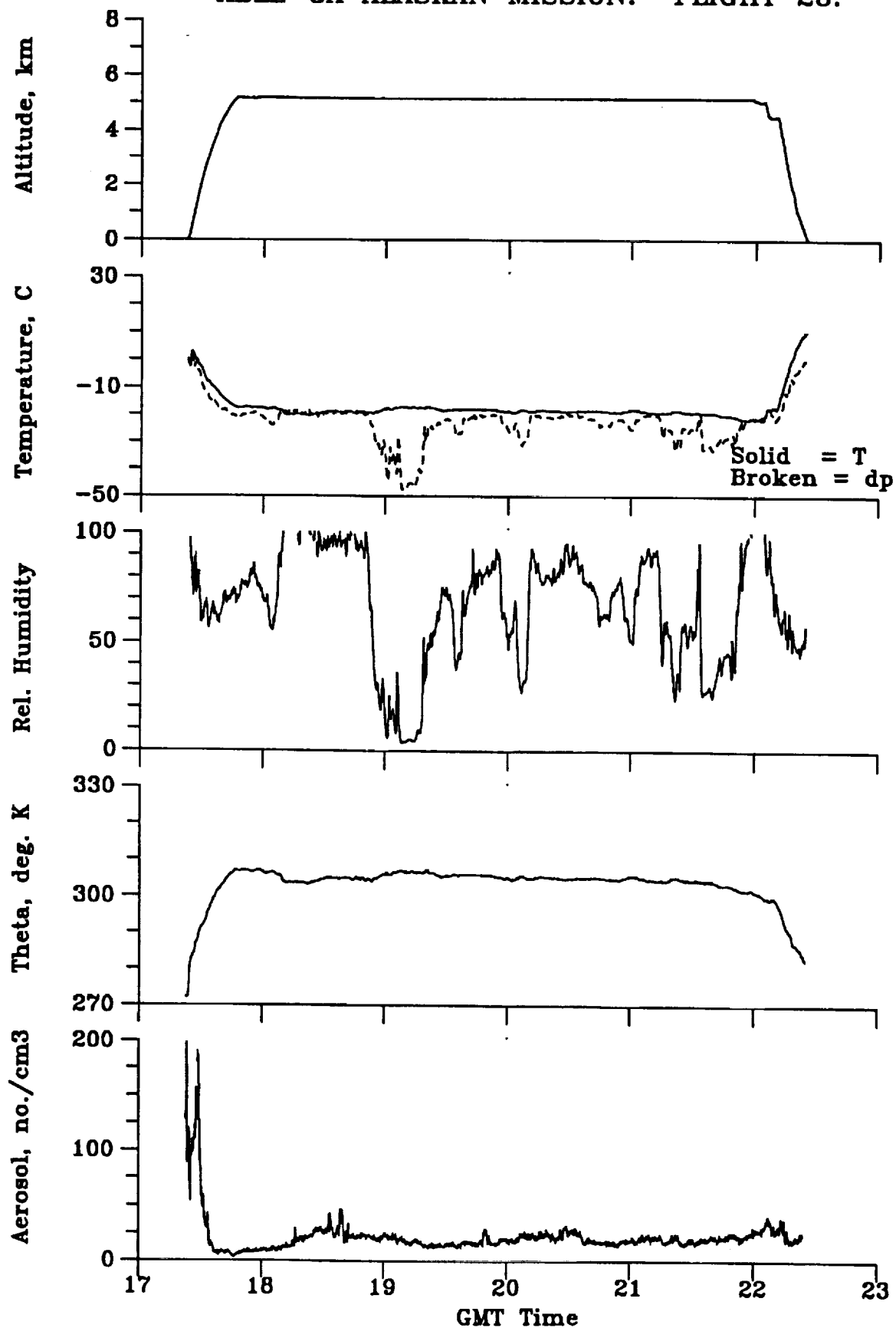


Figure A28.1

ABLE-3A ALASKAN MISSION: FLIGHT 28.

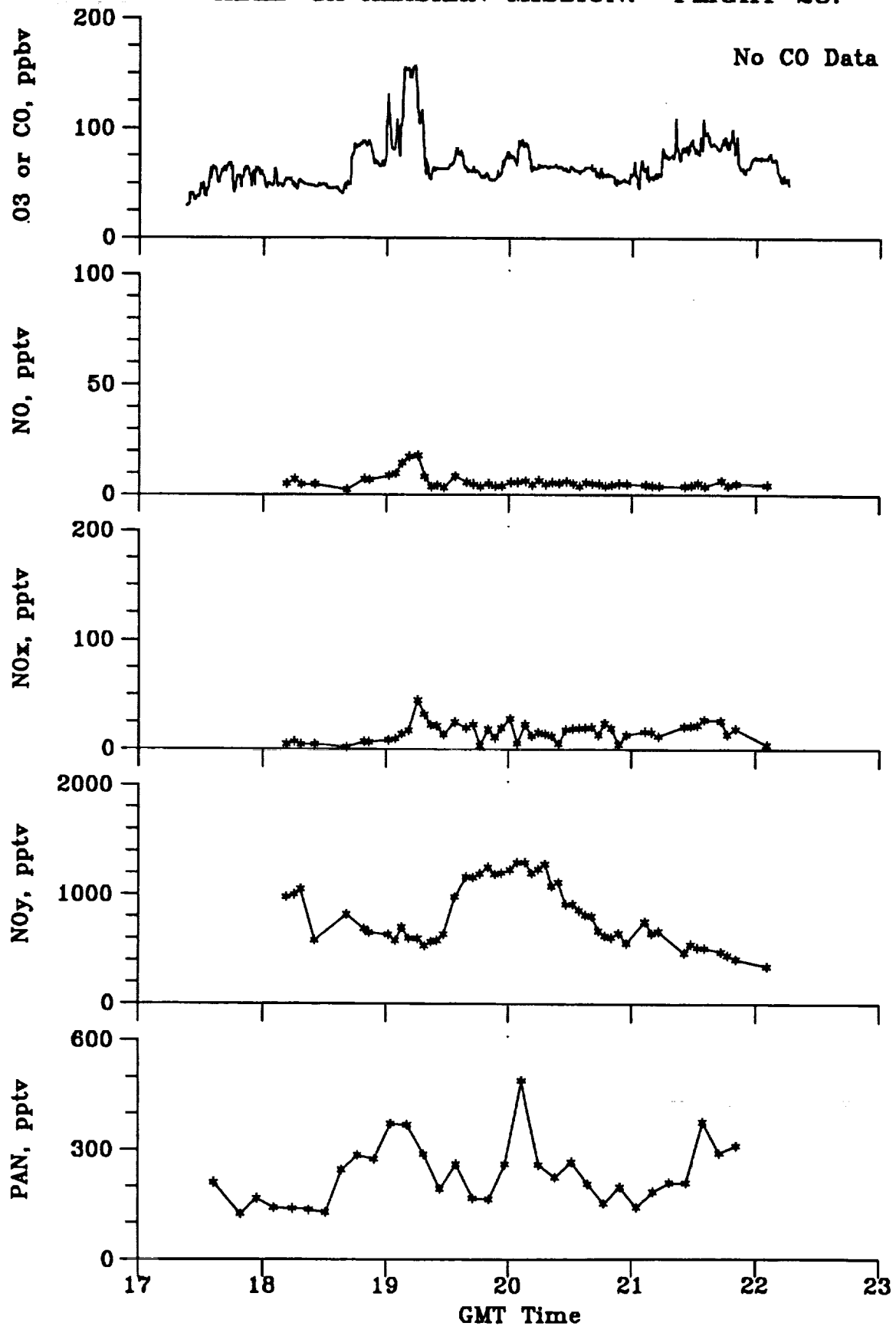


Figure A28.2



# ABLE-3A ALASKAN MISSION: FLIGHT 28.

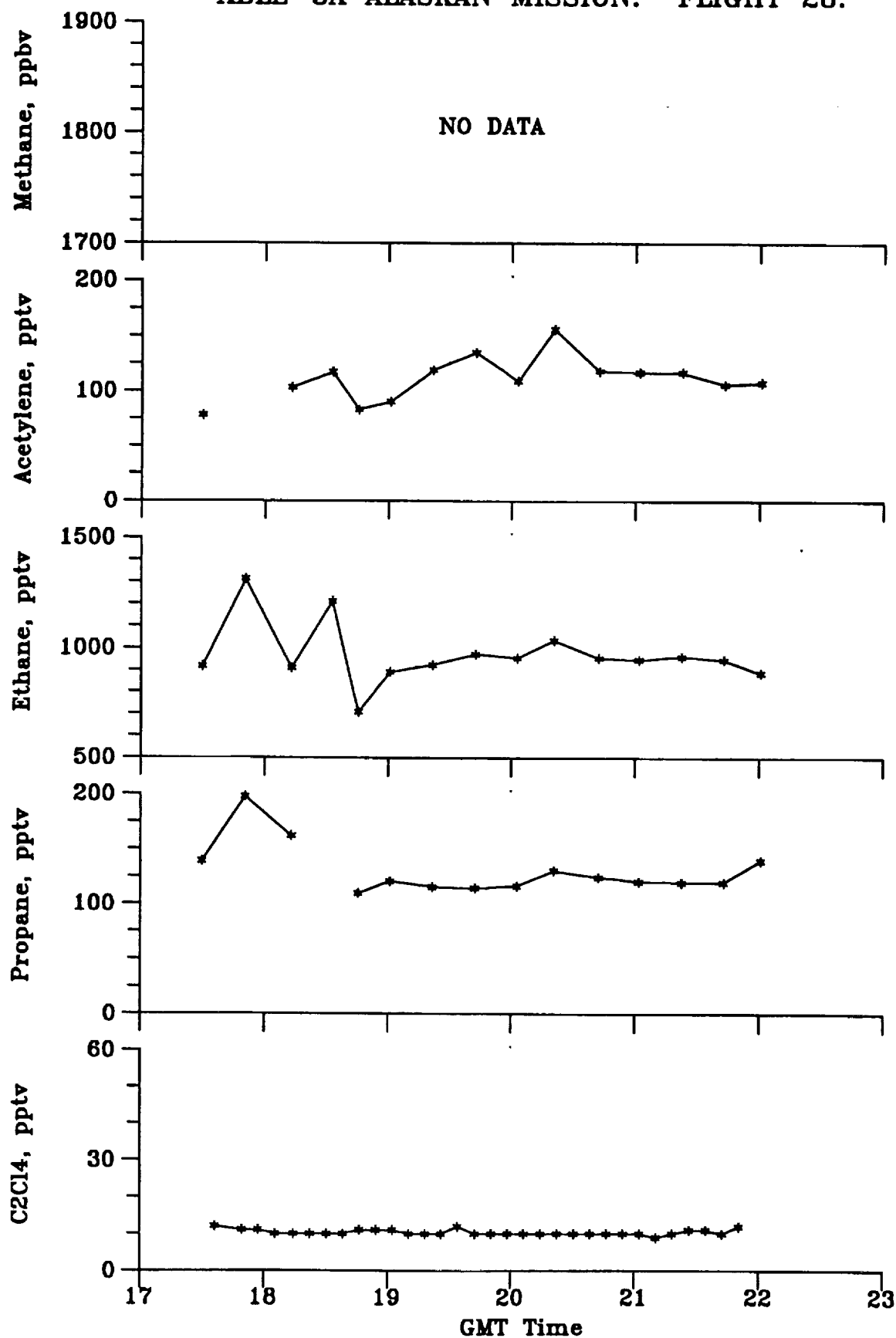
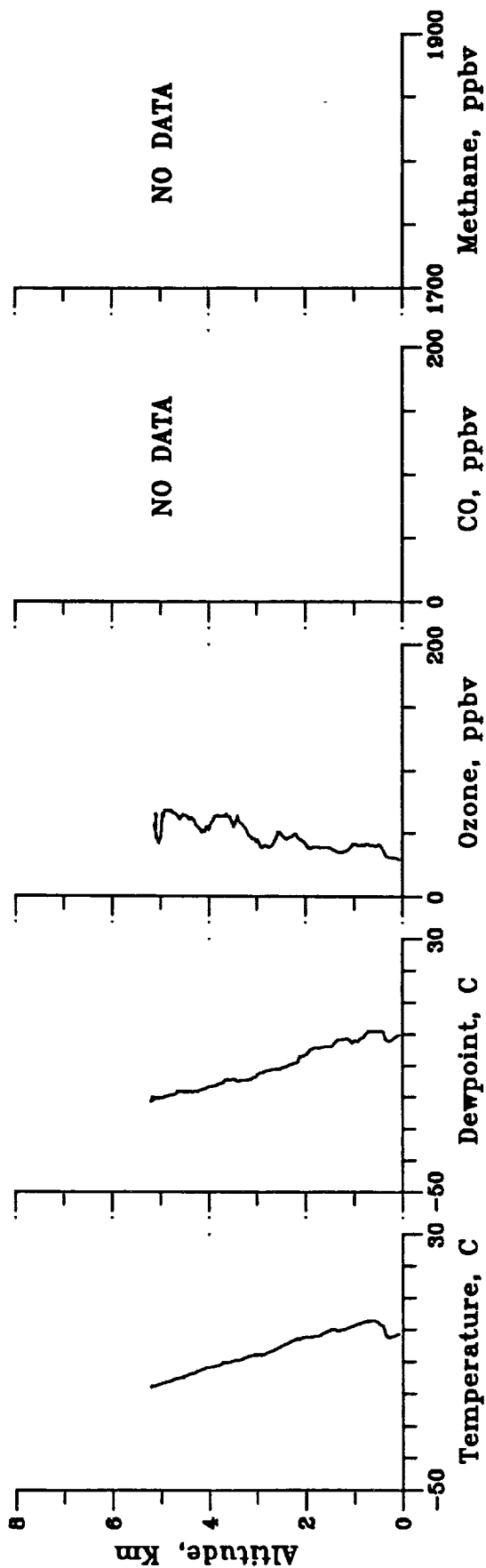


Figure A28.3

ABLE-3A ALASKAN MISSION: FLIGHT 28 PROFILE AT 1730 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 28 PROFILE AT 2215 GMT

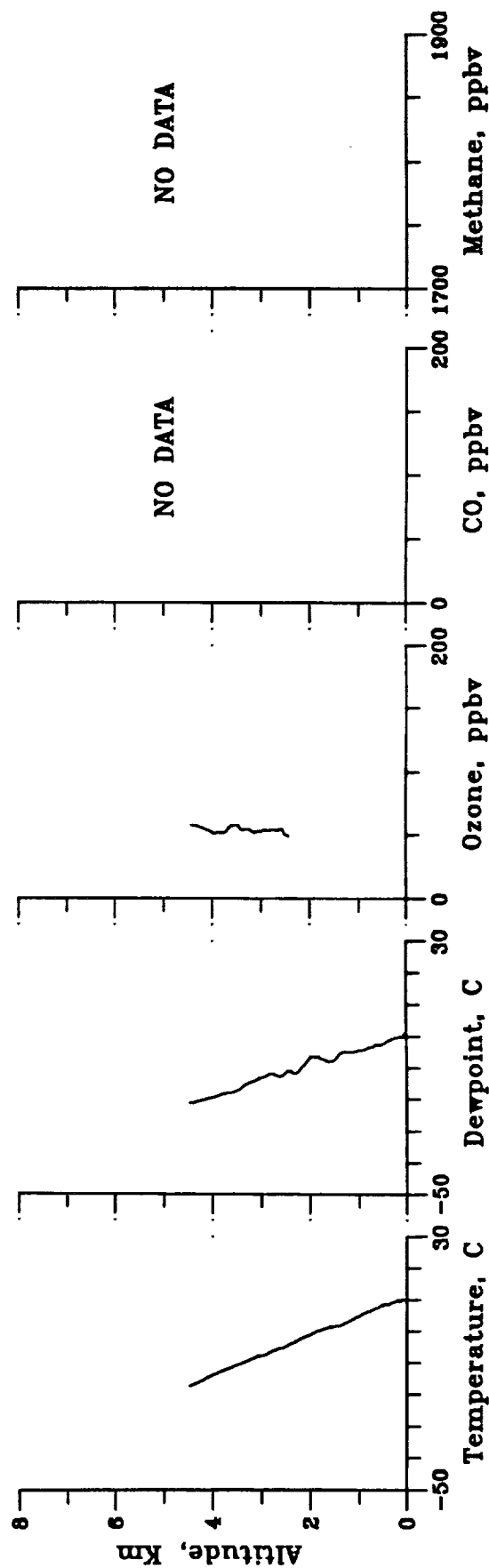


Figure A28.4

# ABLE-3A ALASKAN MISSION: FLIGHT 29.

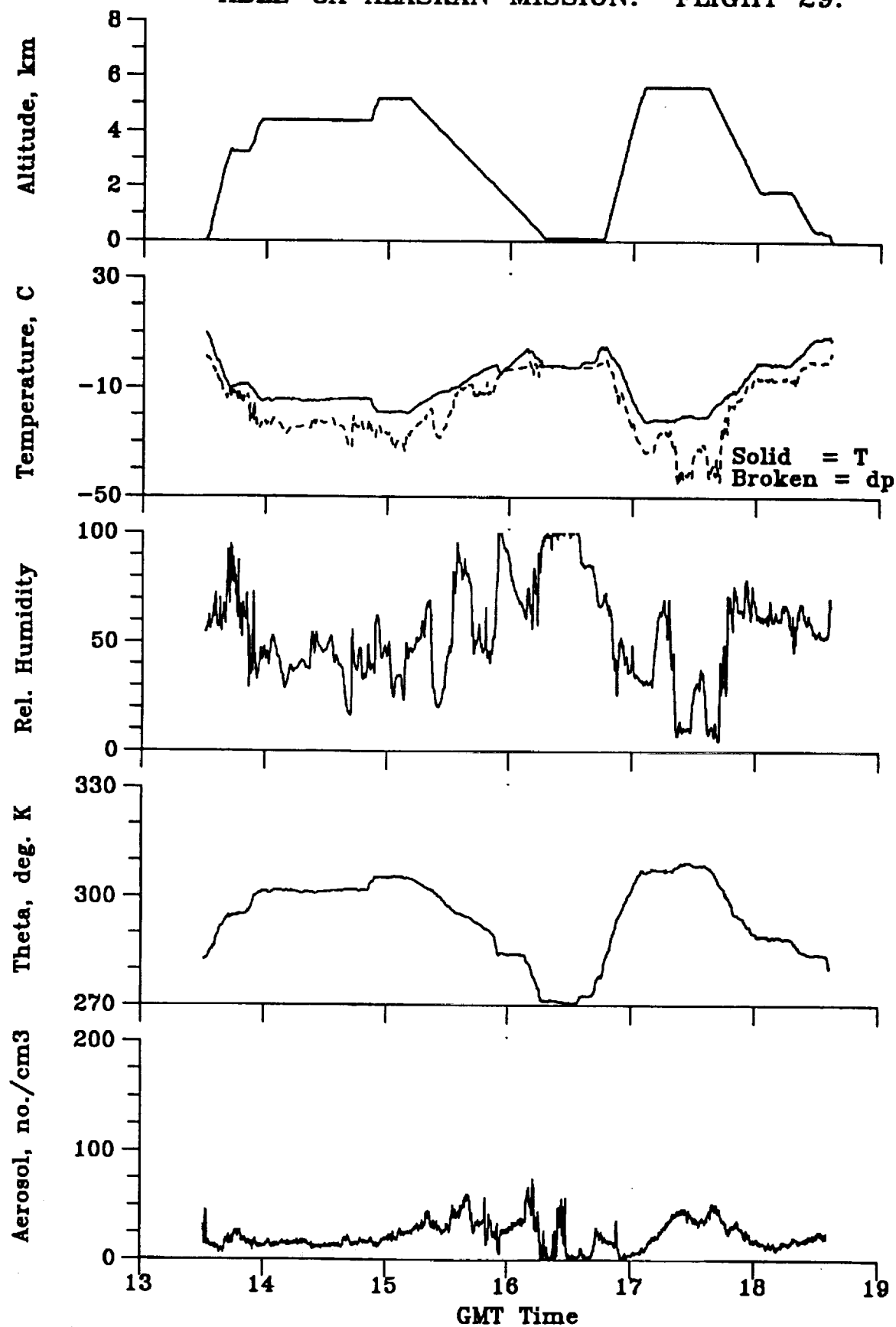


Figure A29.1

# ABLE-3A ALASKAN MISSION: FLIGHT 29.

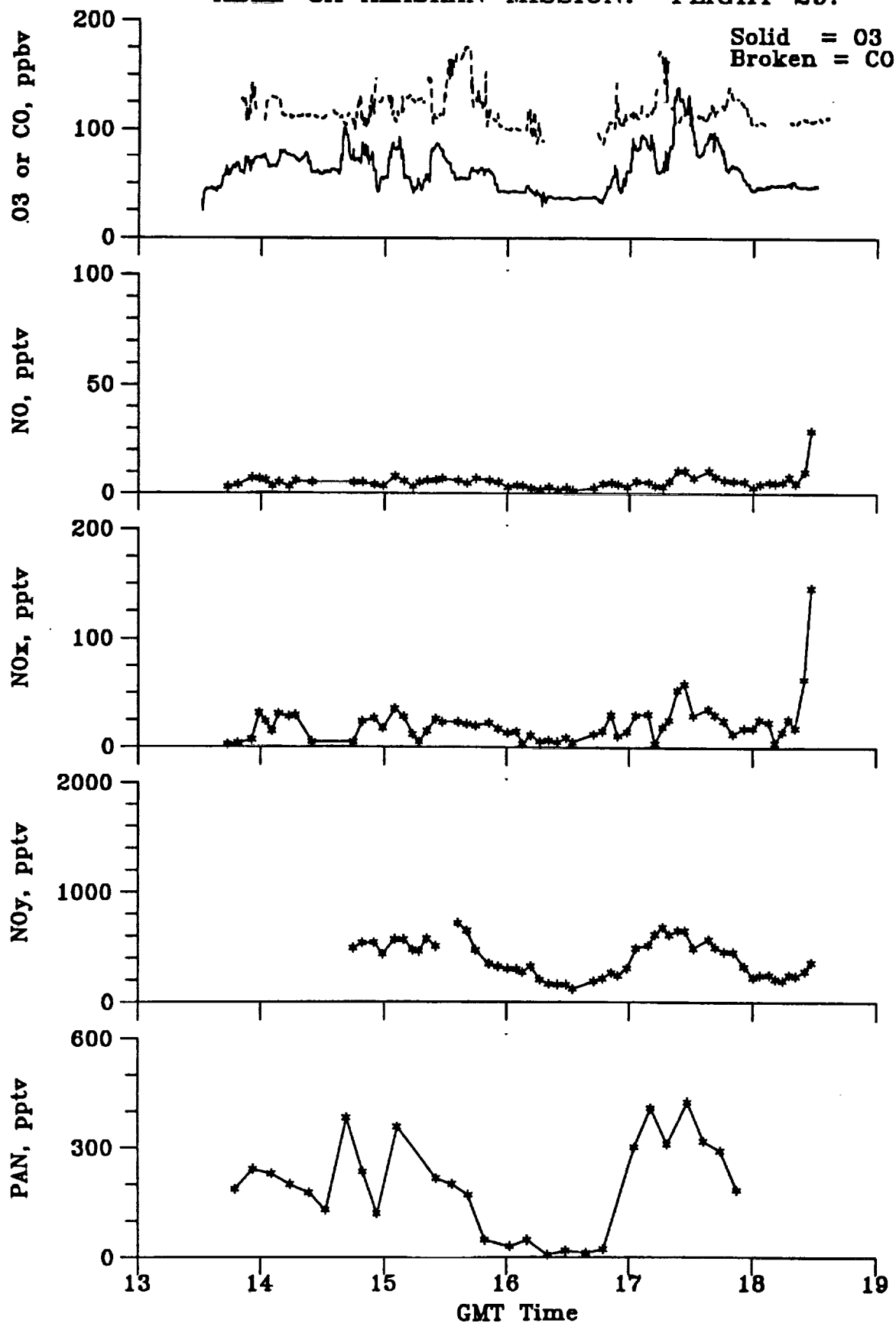


Figure A29.2

# ABLE-3A ALASKAN MISSION: FLIGHT 29.

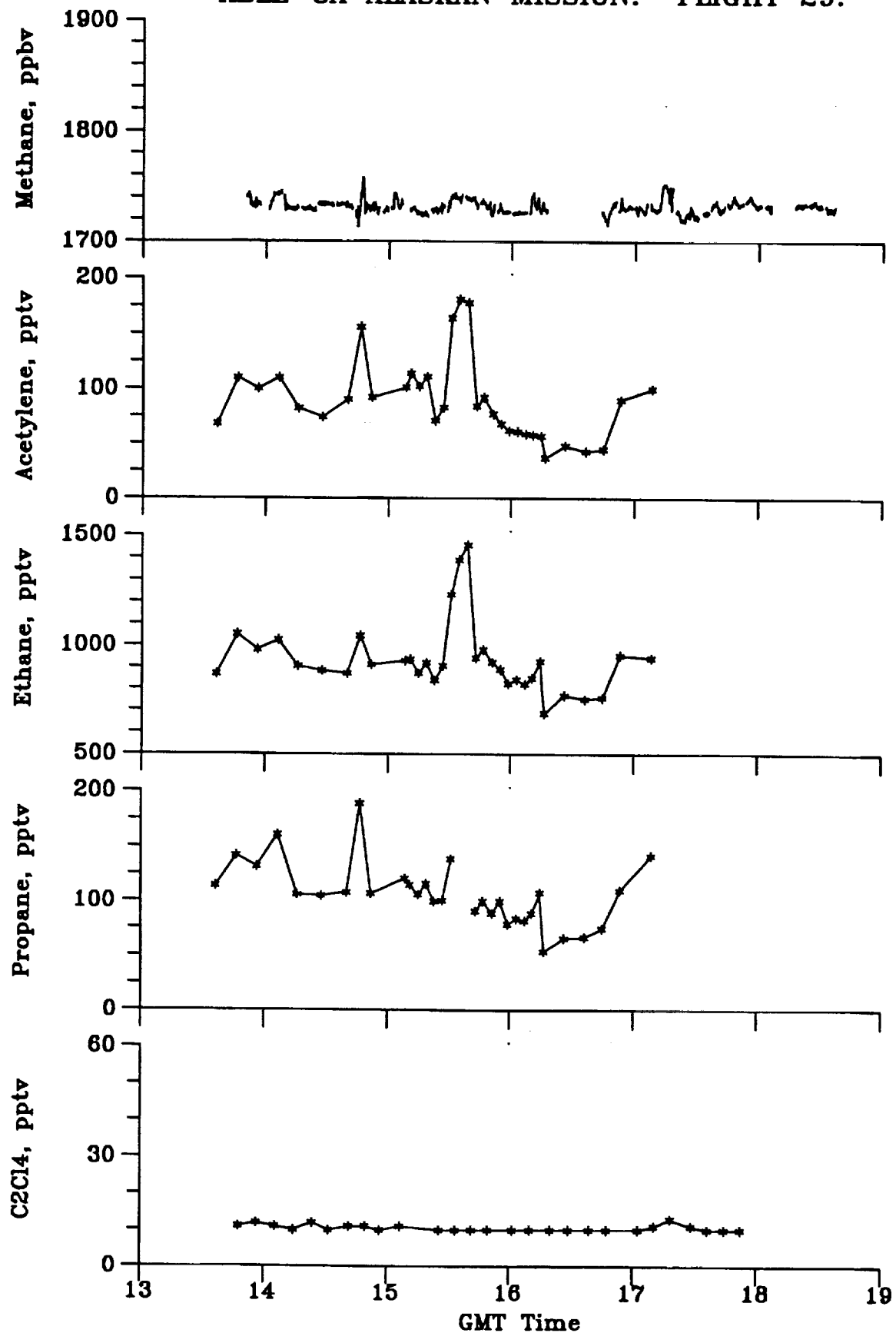
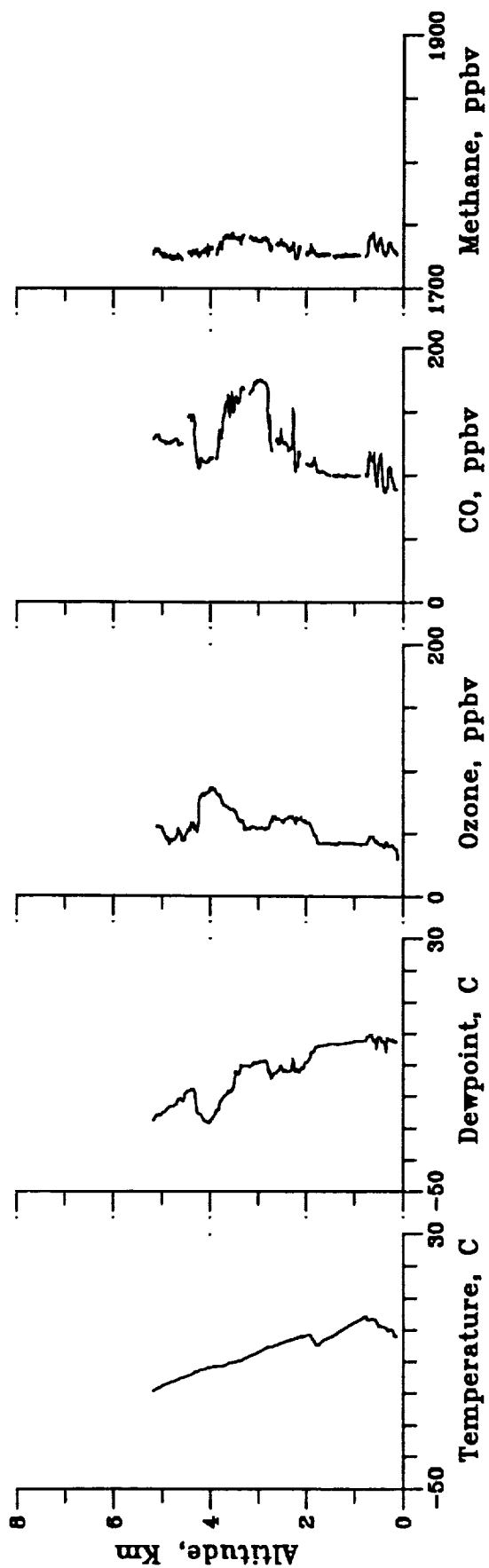


Figure A29.3

ABLE-3A ALASKAN MISSION: FLIGHT 29 PROFILE AT 1530 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 29 PROFILE AT 1700 GMT

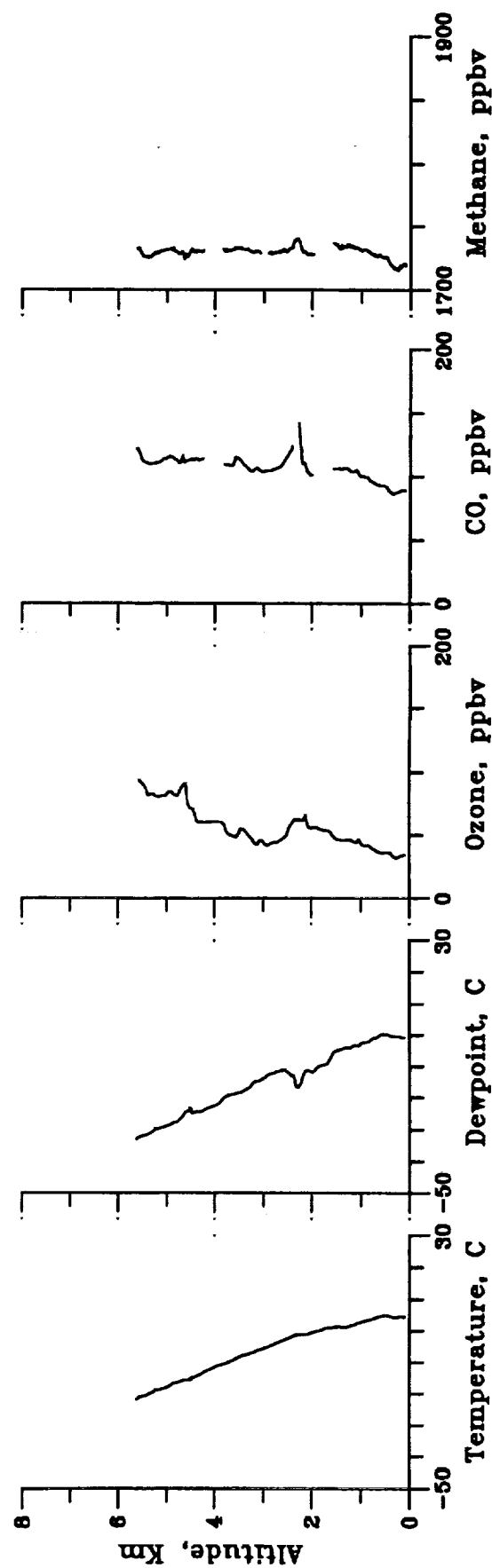


Figure A29.4

# ABLE-3A ALASKAN MISSION: FLIGHT 30.

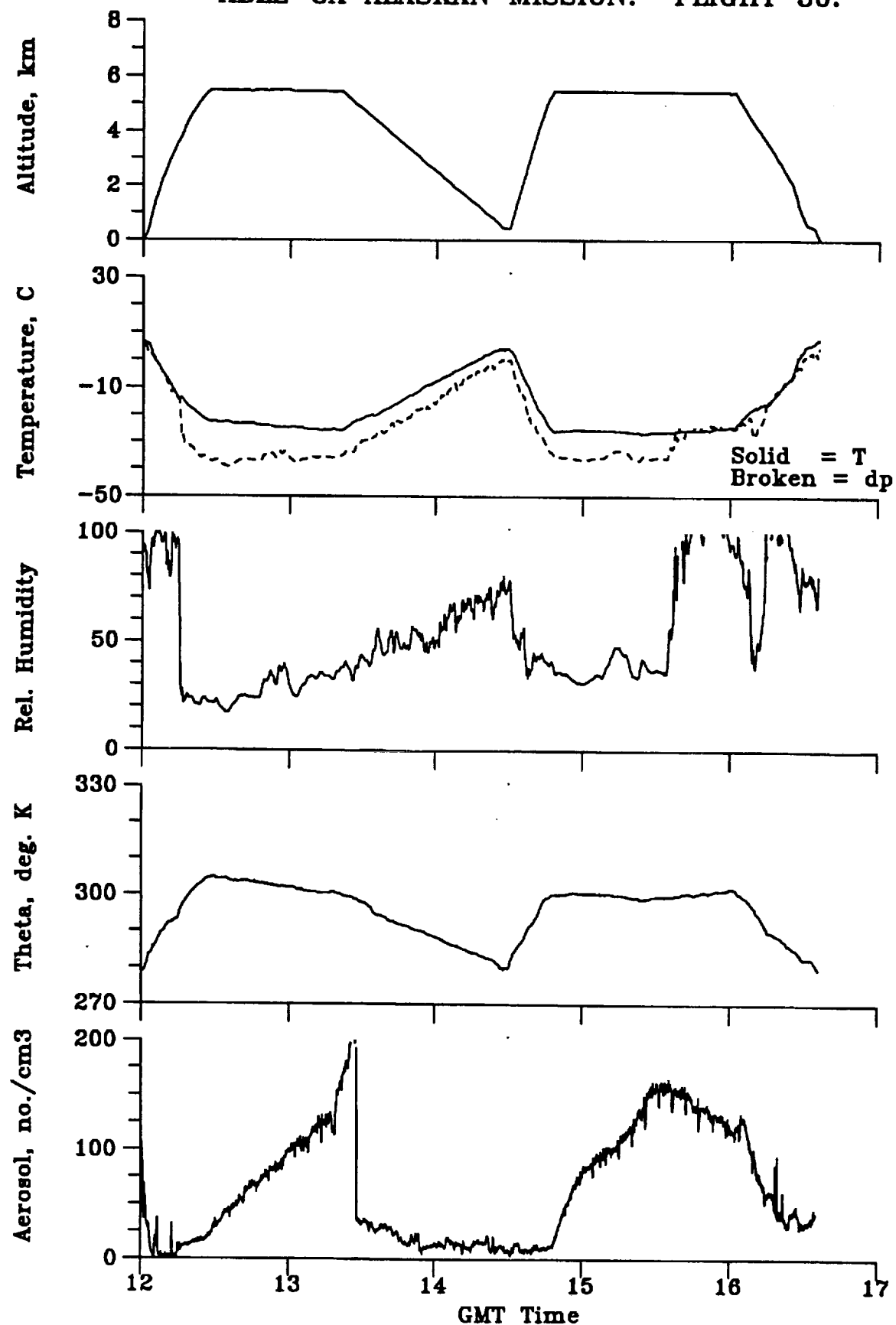


Figure A30.1

# ABLE-3A ALASKAN MISSION: FLIGHT 30.

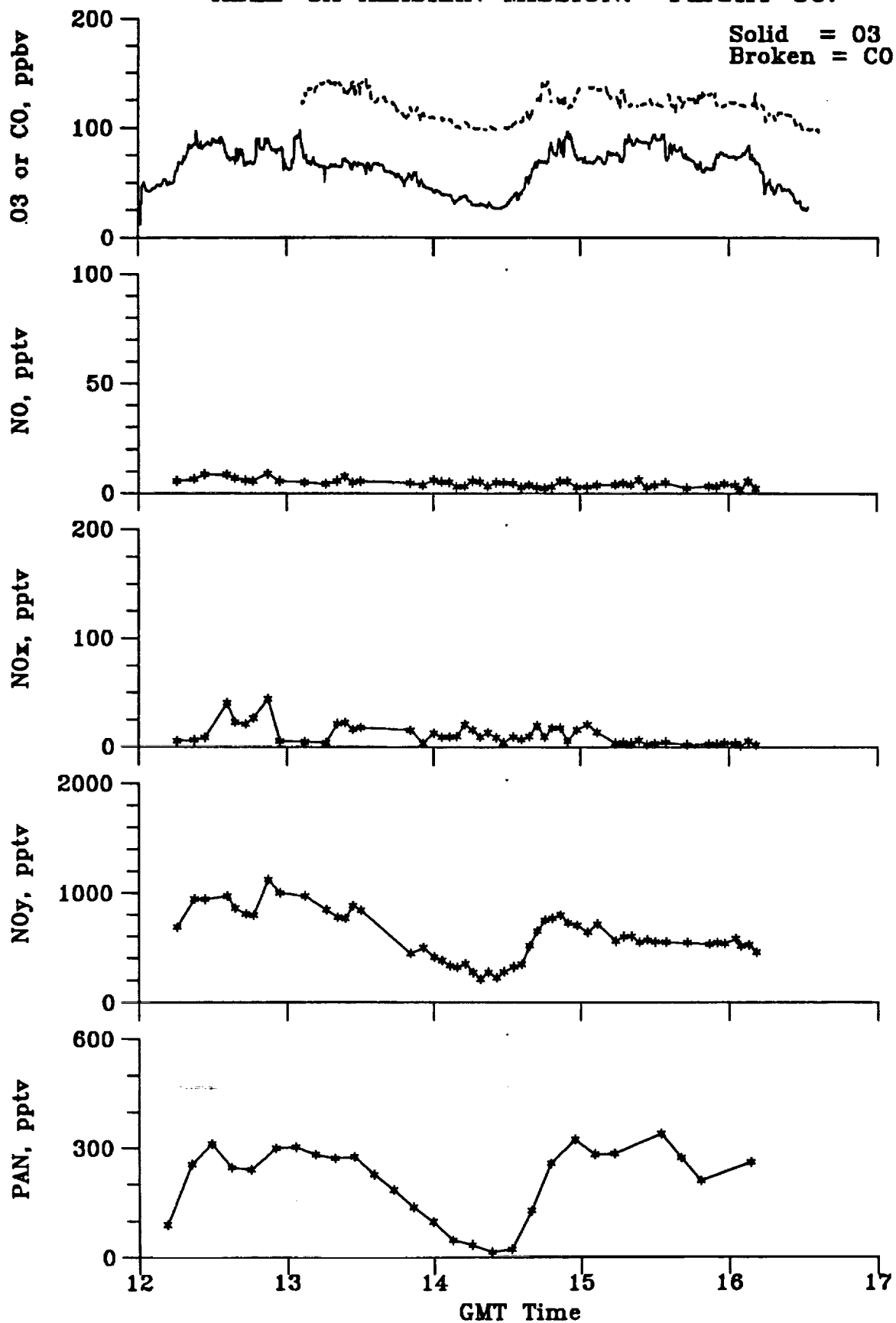


Figure A30.2



# ABLE-3A ALASKAN MISSION: FLIGHT 30.

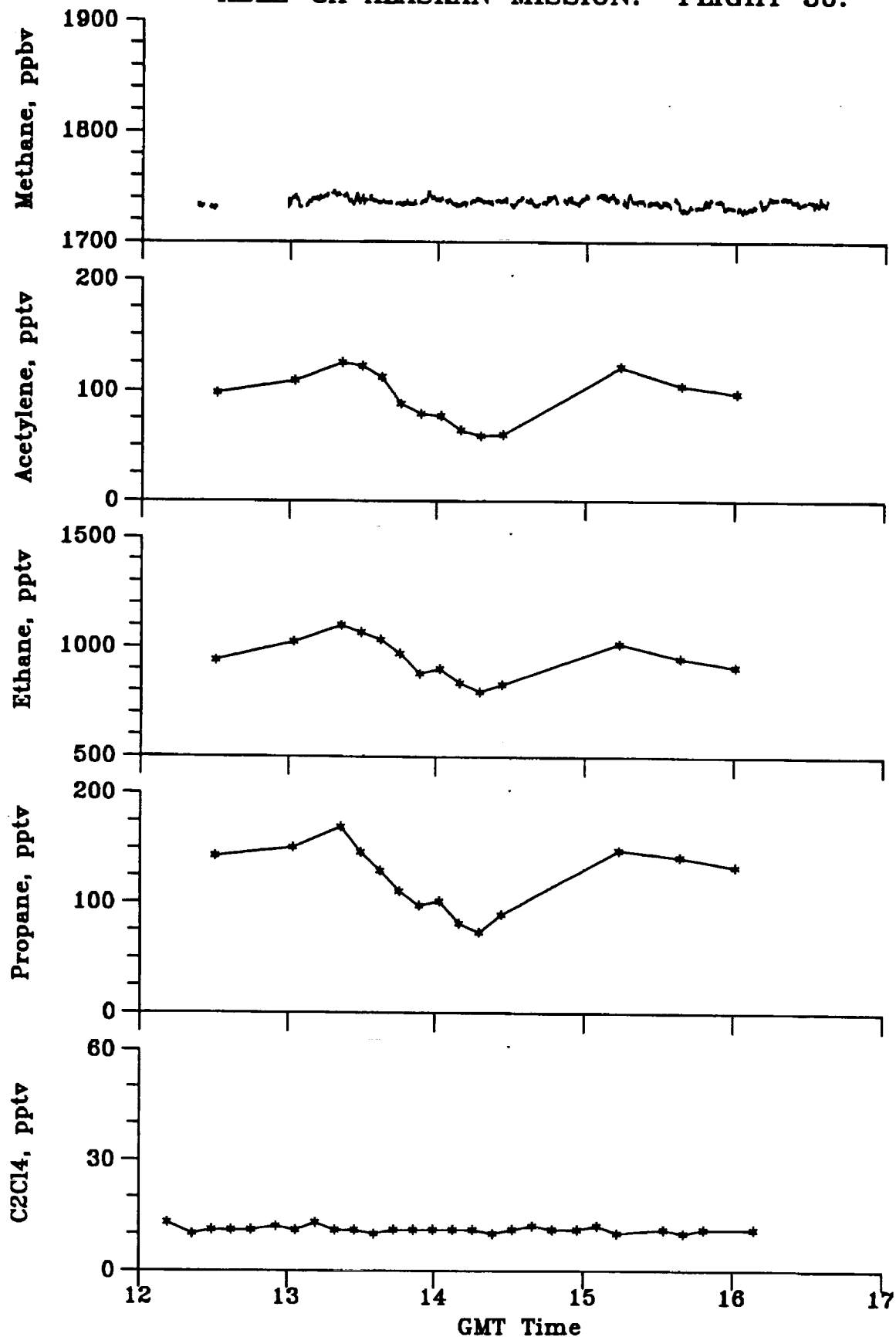
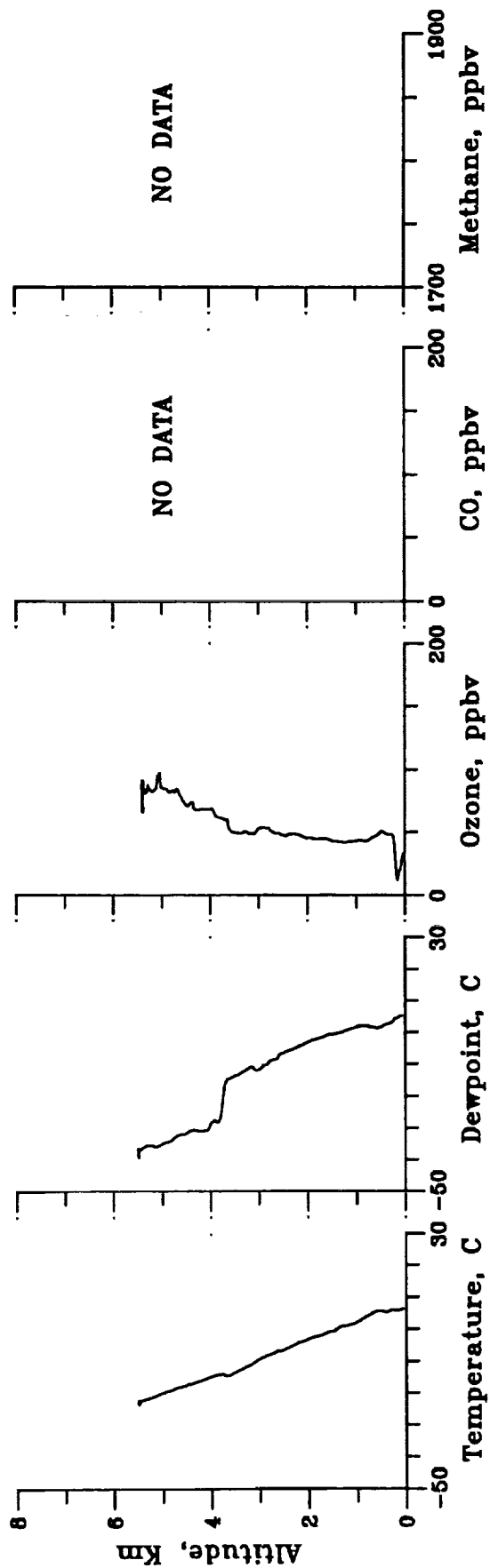


Figure A30.3

ABLE-3A ALASKAN MISSION: FLIGHT 30 PROFILE AT 1230 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 30 PROFILE AT 1400 GMT

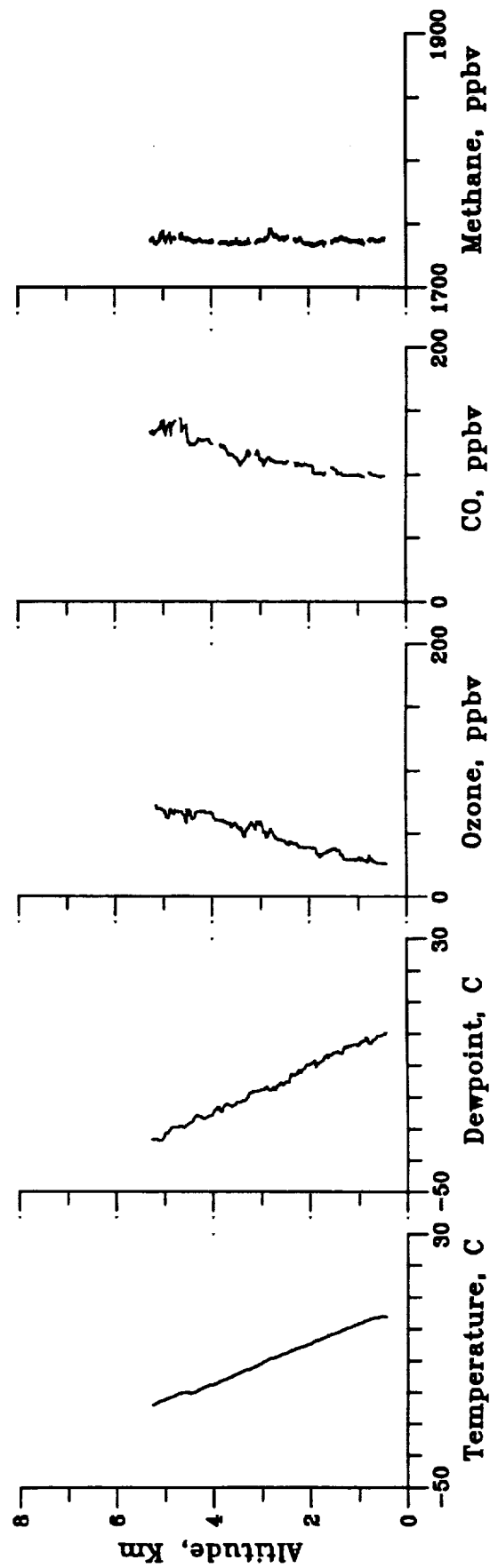


Figure A30.4

ABLE-3A ALASKAN MISSION: FLIGHT 30 PROFILE AT 1615 GMT

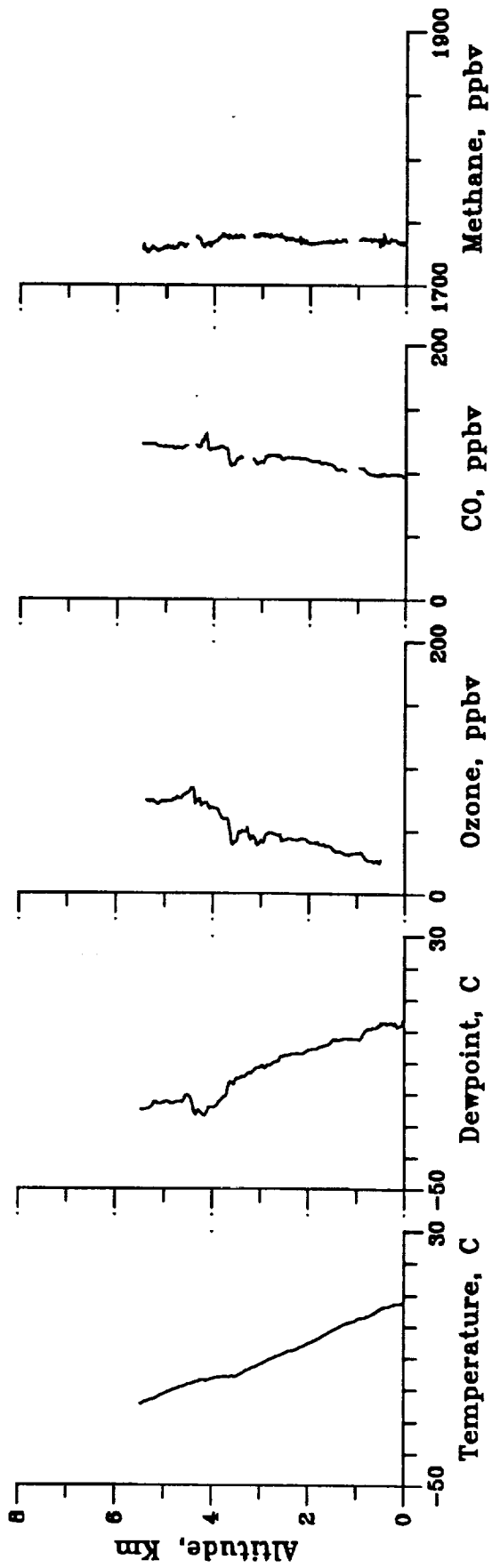


Figure A30.5

# ABLE-3A ALASKAN MISSION: FLIGHT 31.

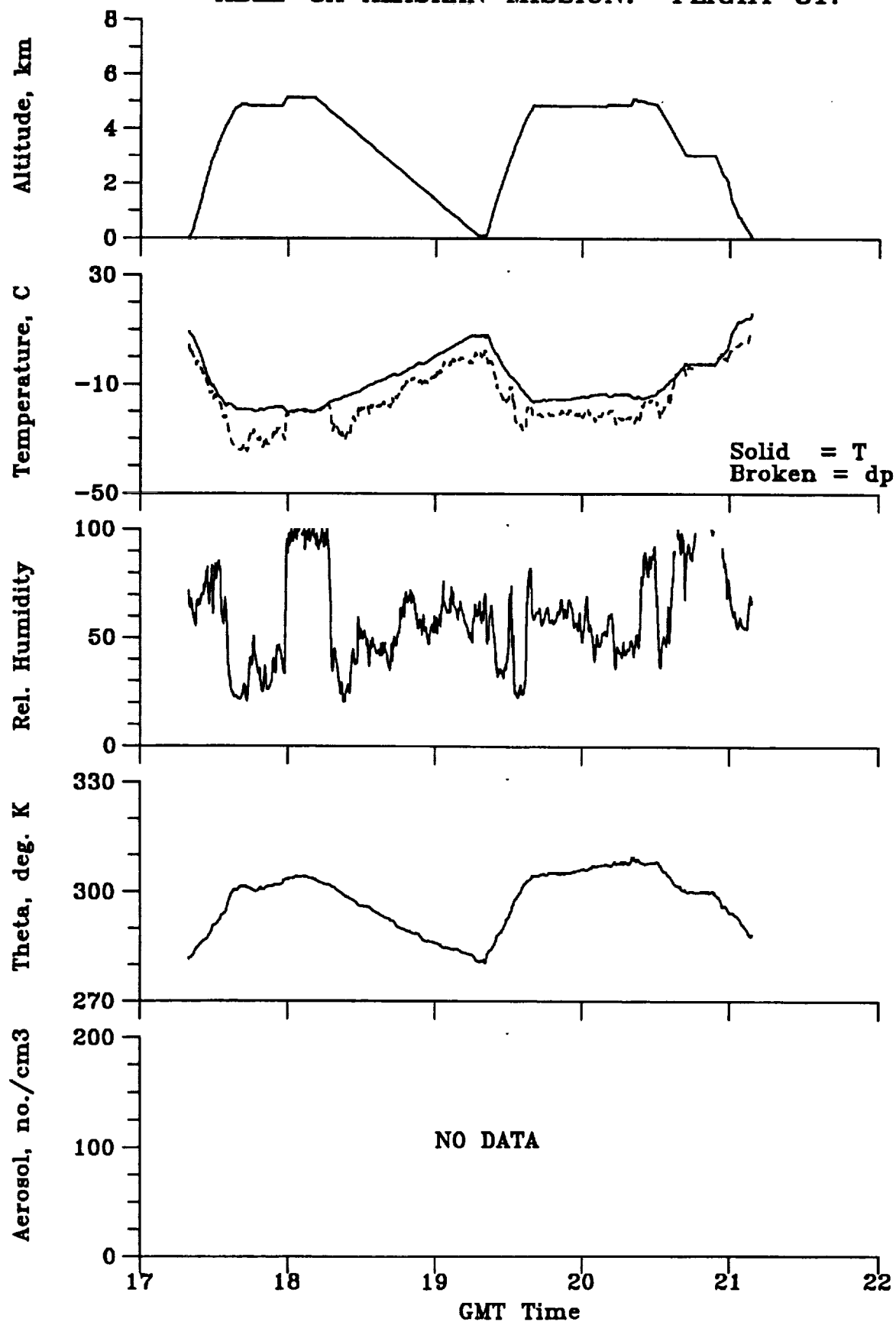


Figure A31.1

ABLE-3A ALASKAN MISSION: FLIGHT 31.

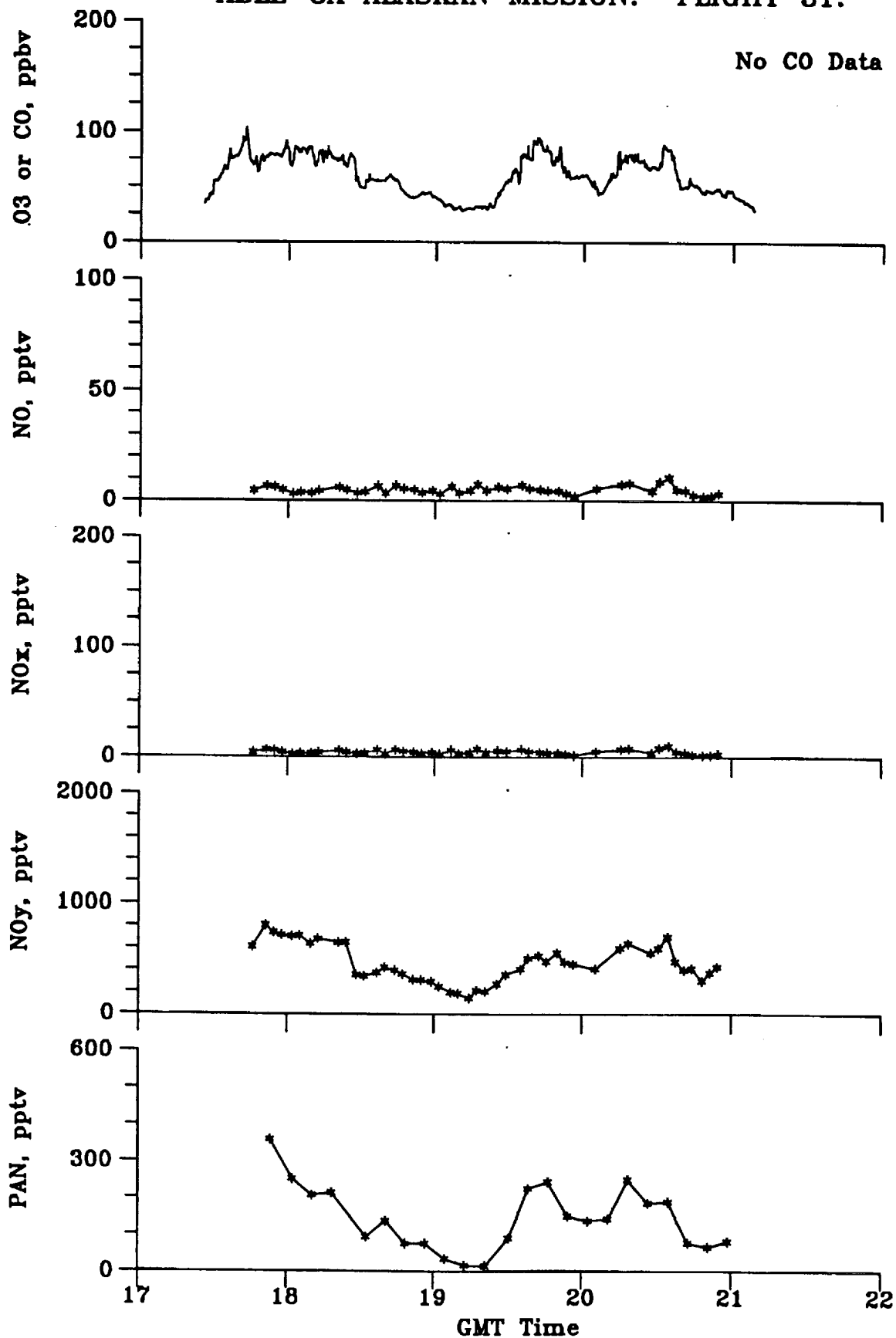


Figure A31.2

# ABLE-3A ALASKAN MISSION: FLIGHT 31.

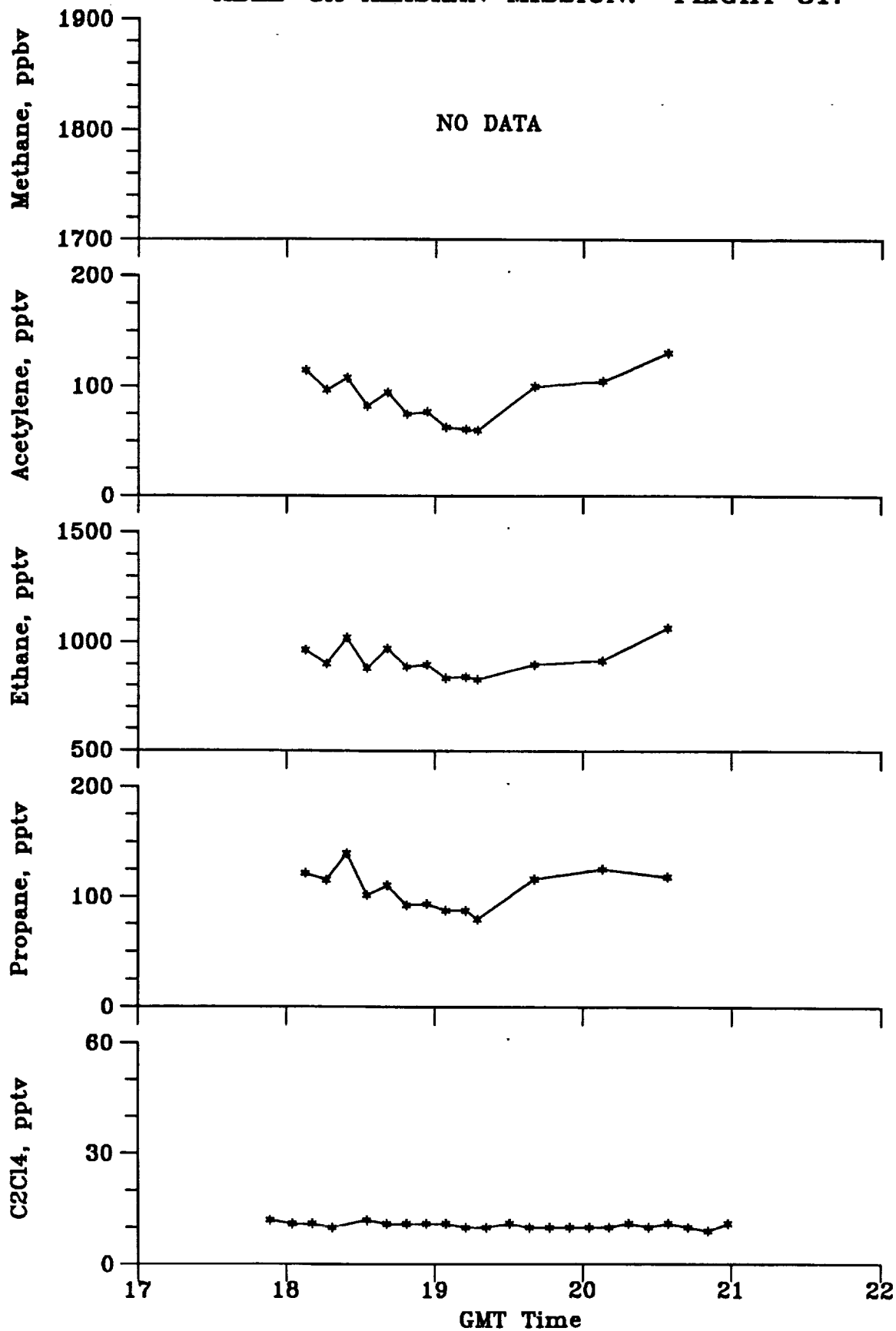
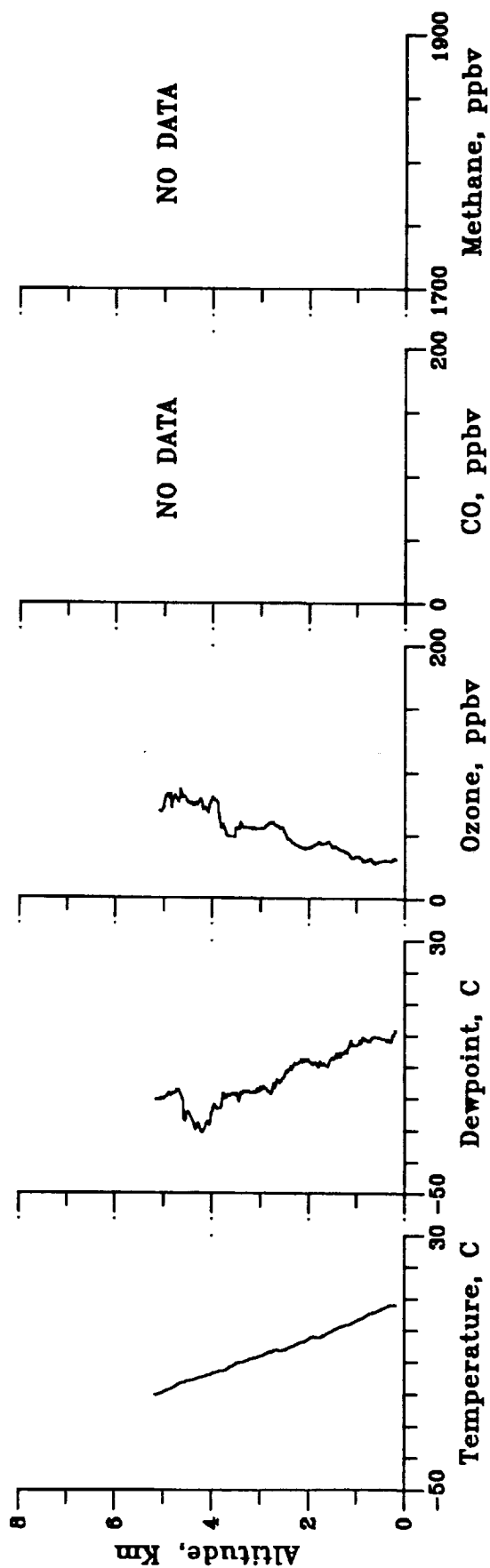


Figure A31.3

ABLE-3A ALASKAN MISSION: FLIGHT 31 PROFILE AT 1845 GMT



ABLE-3A ALASKAN MISSION: FLIGHT 31 PROFILE AT 2045 GMT

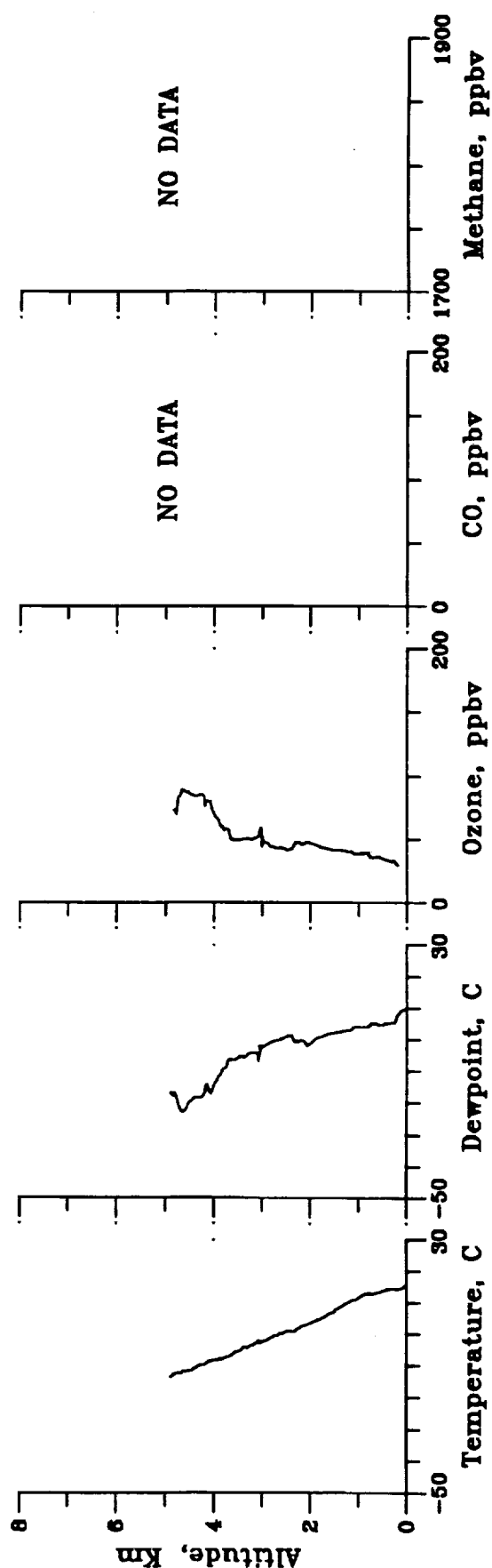


Figure A31.4

# ABLE-3A ALASKAN MISSION: FLIGHT 32.

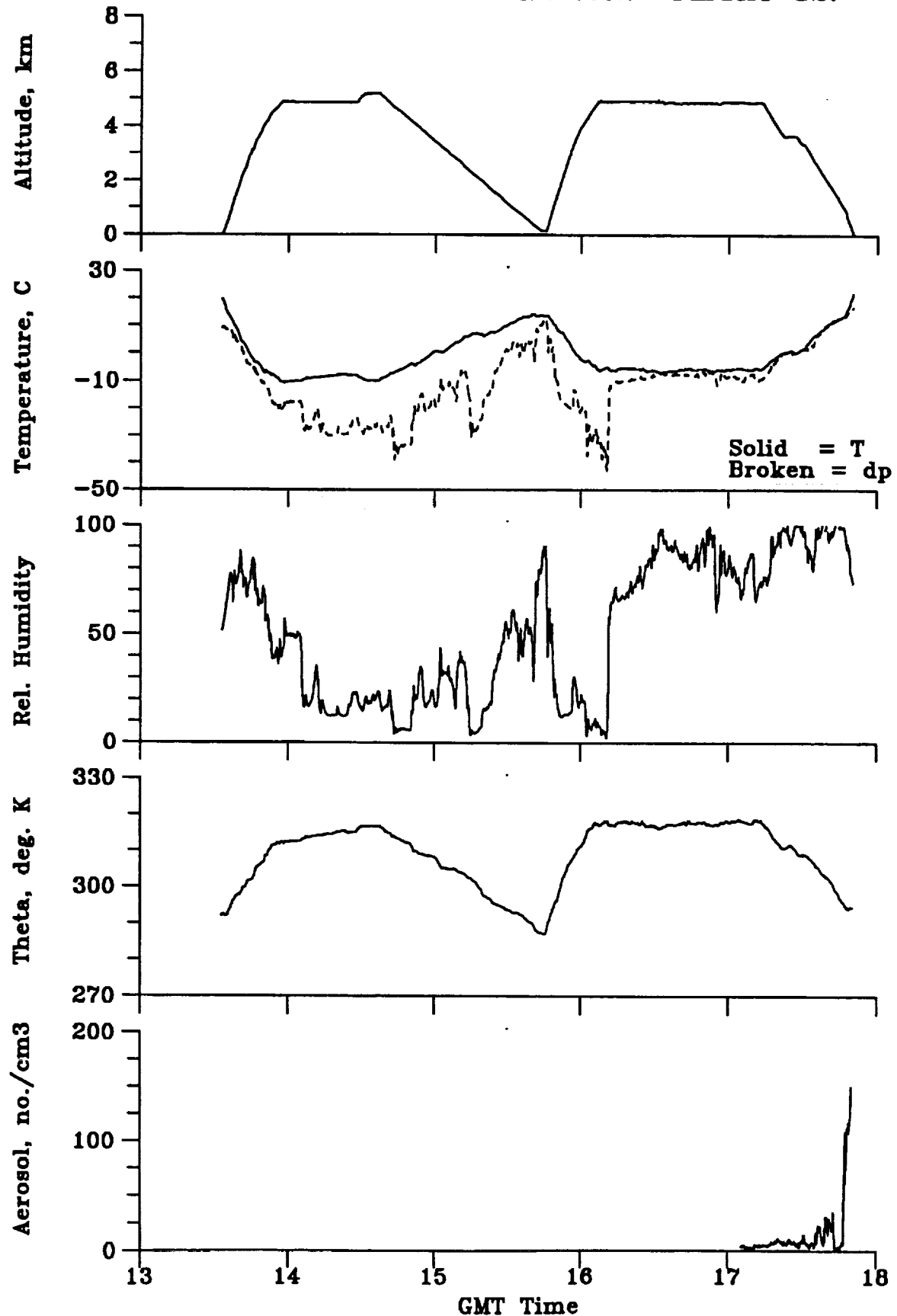


Figure A32.1



# ABLE-3A ALASKAN MISSION: FLIGHT 32.

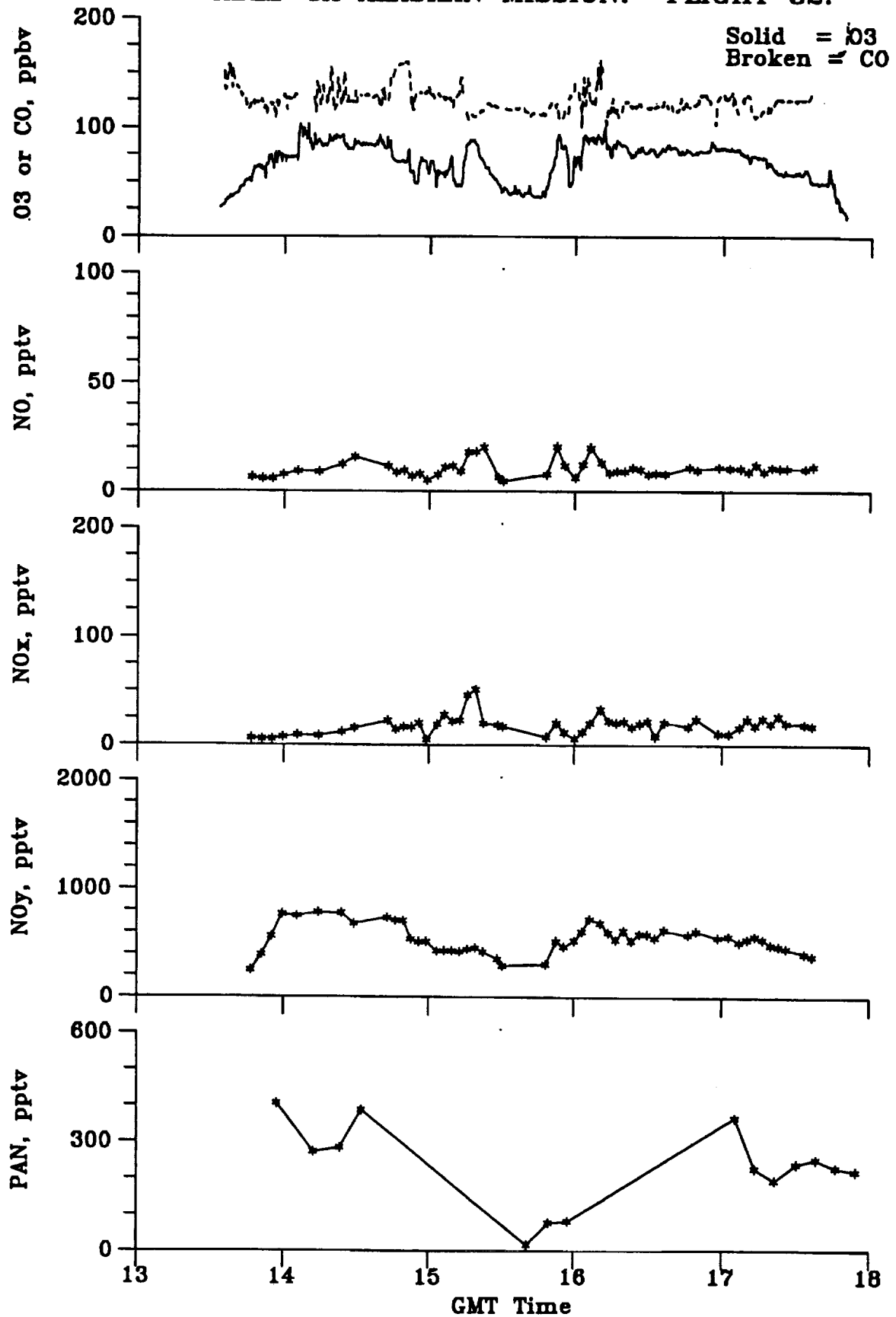


Figure A32.2

# ABLE-3A ALASKAN MISSION: FLIGHT 32.

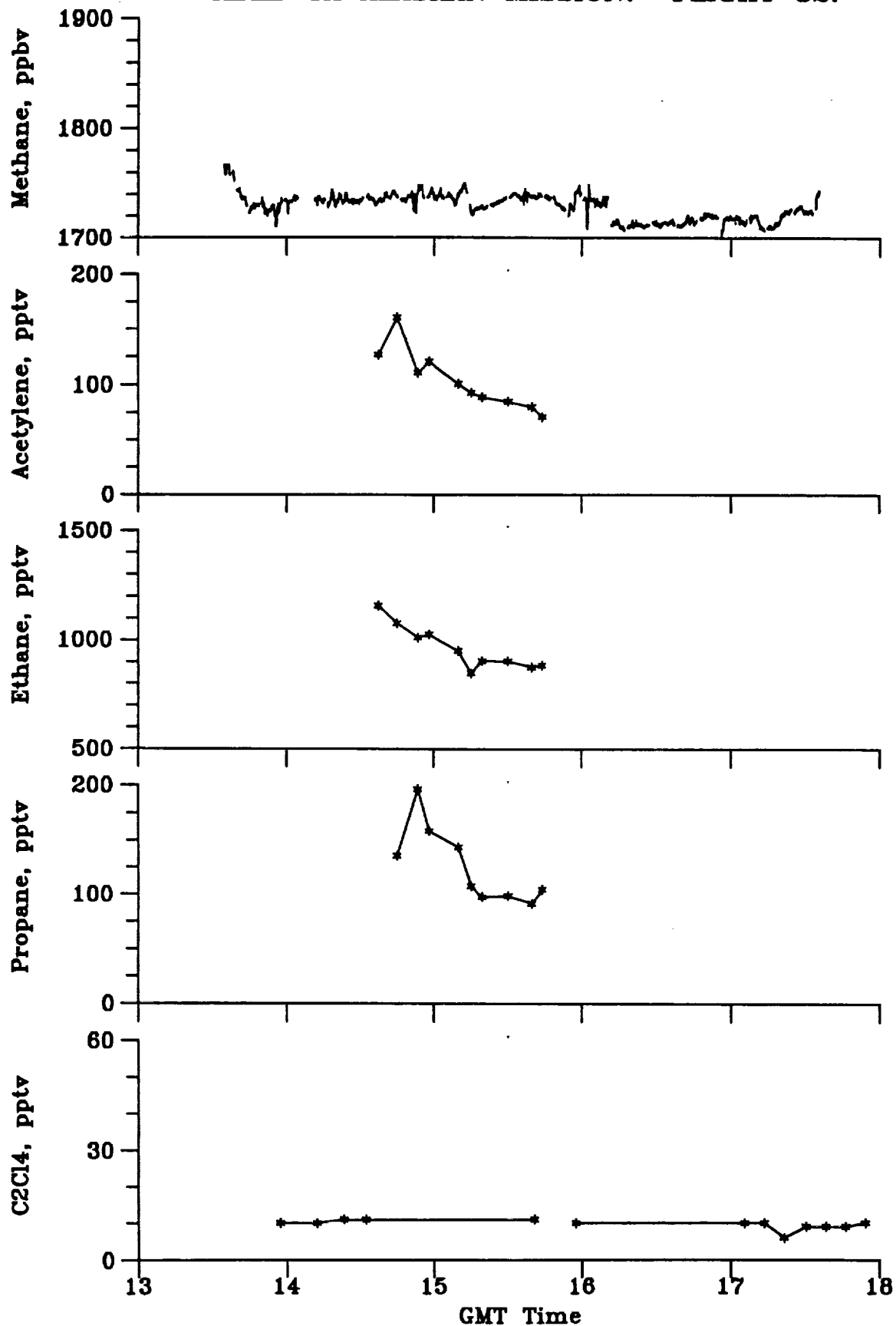


Figure A32.3

ABLE-3A ALASKAN MISSION: FLIGHT 32 PROFILE AT 1515 GMT

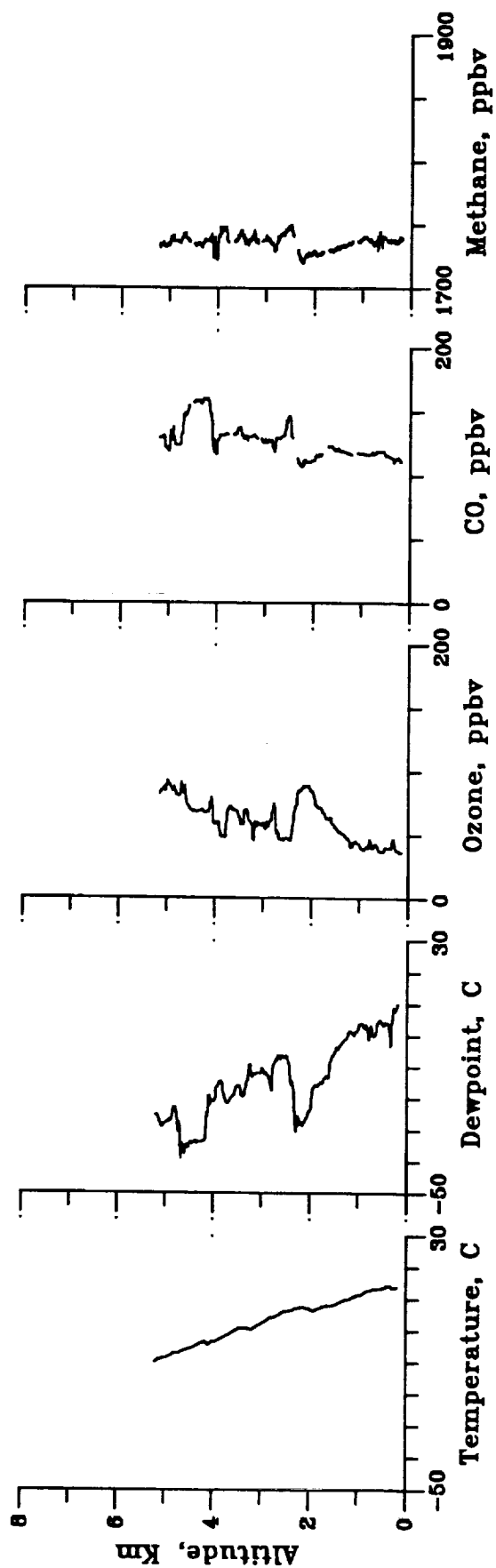


Figure A32.4

ABLE-3A ALASKAN MISSION: FLIGHT 33.

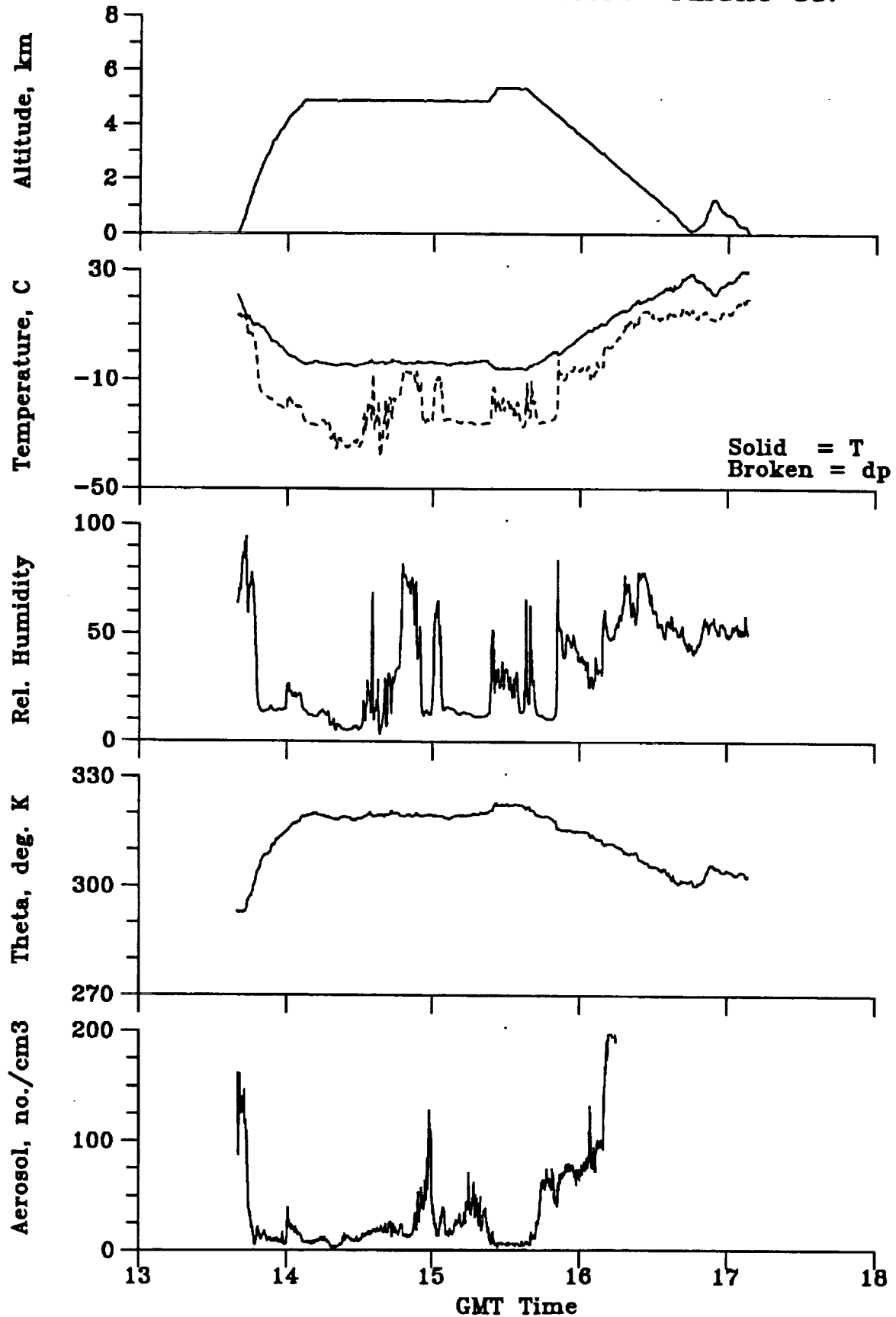


Figure A33.1

# ABLE-3A ALASKAN MISSION: FLIGHT 33.

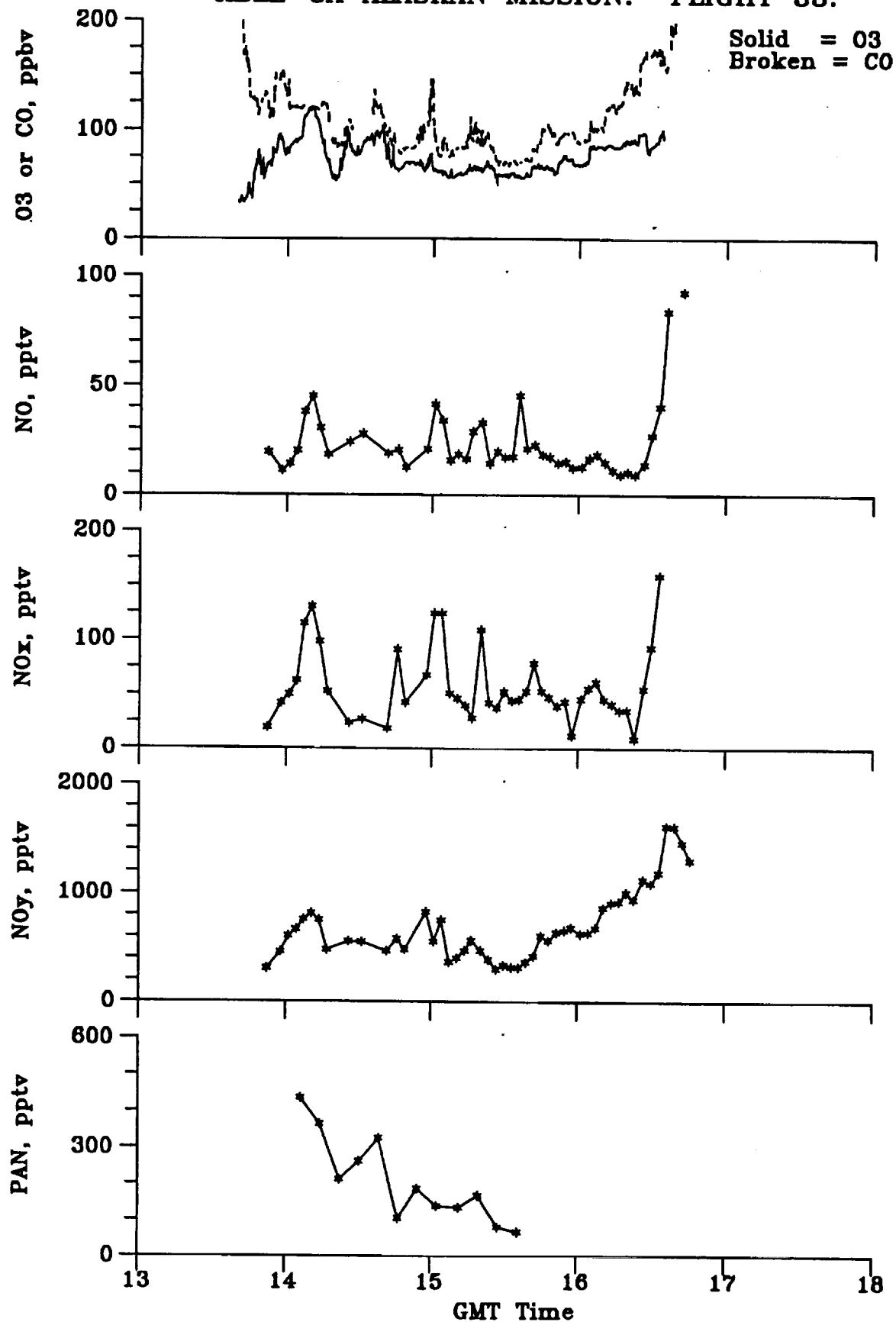


Figure A33.2

# ABLE-3A ALASKAN MISSION: FLIGHT 33.

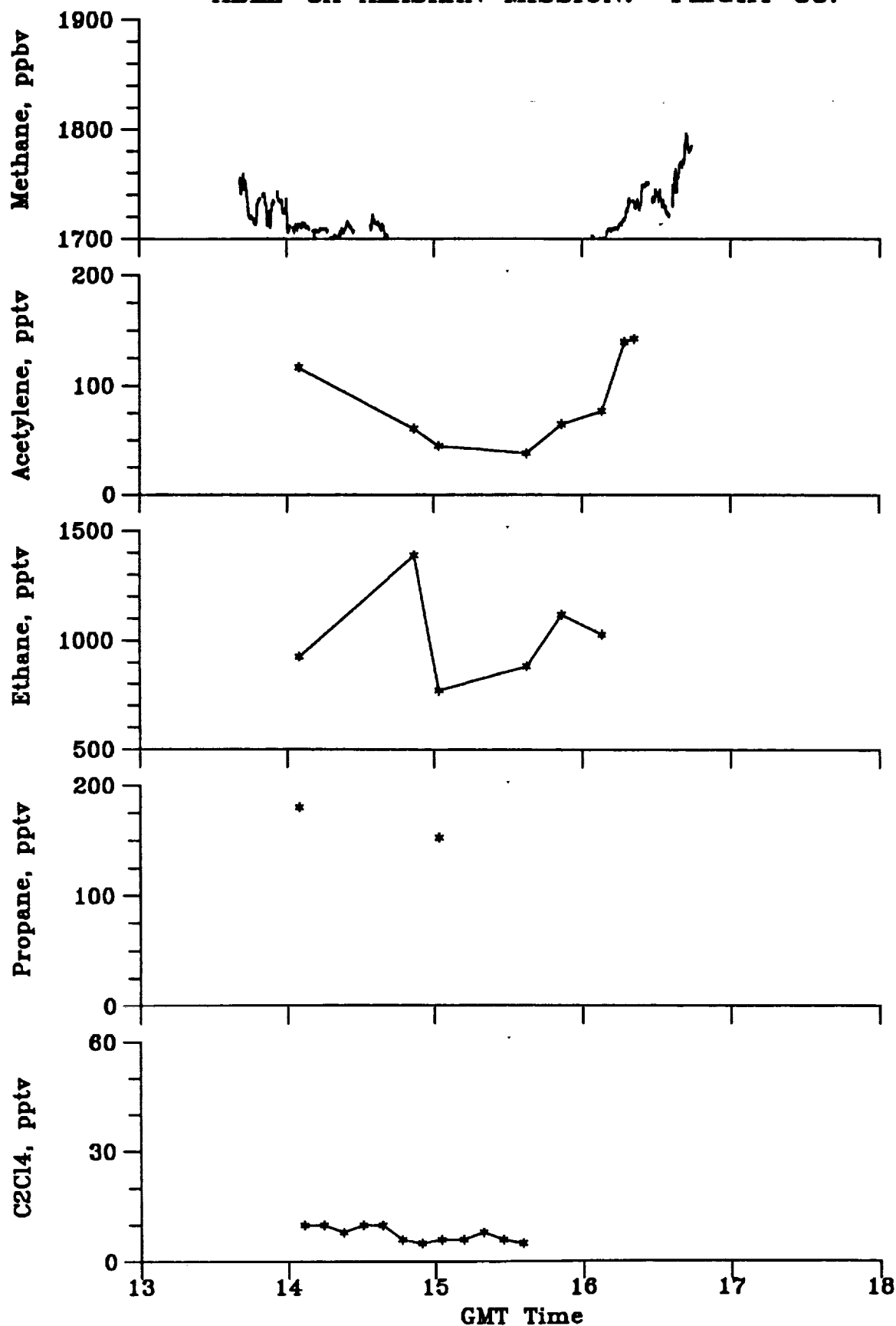


Figure A33.3

ABLE-3A ALASKAN MISSION: FLIGHT 33 PROFILE AT 1615 GMT

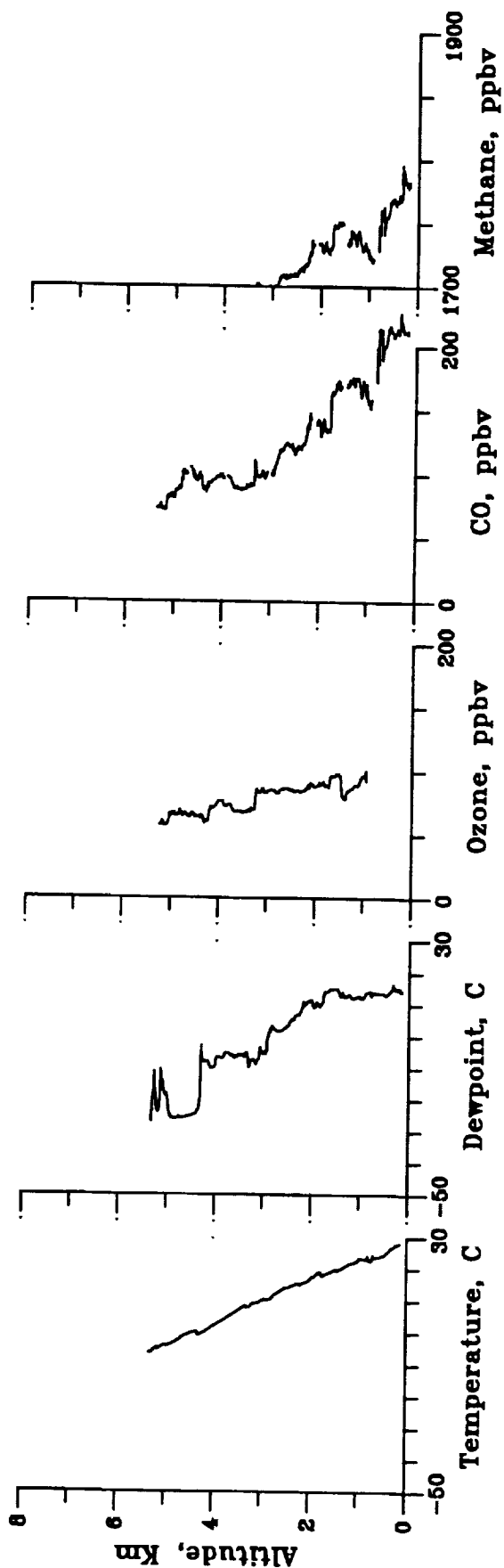


Figure A33.4





## APPENDIX B: ABLE-3B DATA

Given below are the beginning page numbers for each flight's sequence of plots:

Flight 1 - page 160  
Flight 2 - page 165  
Flight 3 - page 170  
Flight 4 - page 175  
Flight 5 - page 180  
Flight 6 - page 185  
Flight 7 - page 190  
Flight 8 - page 195  
Flight 9 - page 200  
Flight 10 - page 205  
Flight 11 - page 210  
Flight 12 - page 215  
Flight 13 - page 220  
Flight 14 - page 225  
Flight 15 - page 230  
Flight 16 - page 235  
Flight 17 - page 240  
Flight 18 - page 245  
Flight 19 - page 250  
Flight 20 - page 256  
Flight 21 - page 261  
Flight 22 - page 266

PREVIOUS PAGE BLANK NOT FILMED

# ABLE-3B CANADIAN MISSION: FLIGHT 1.

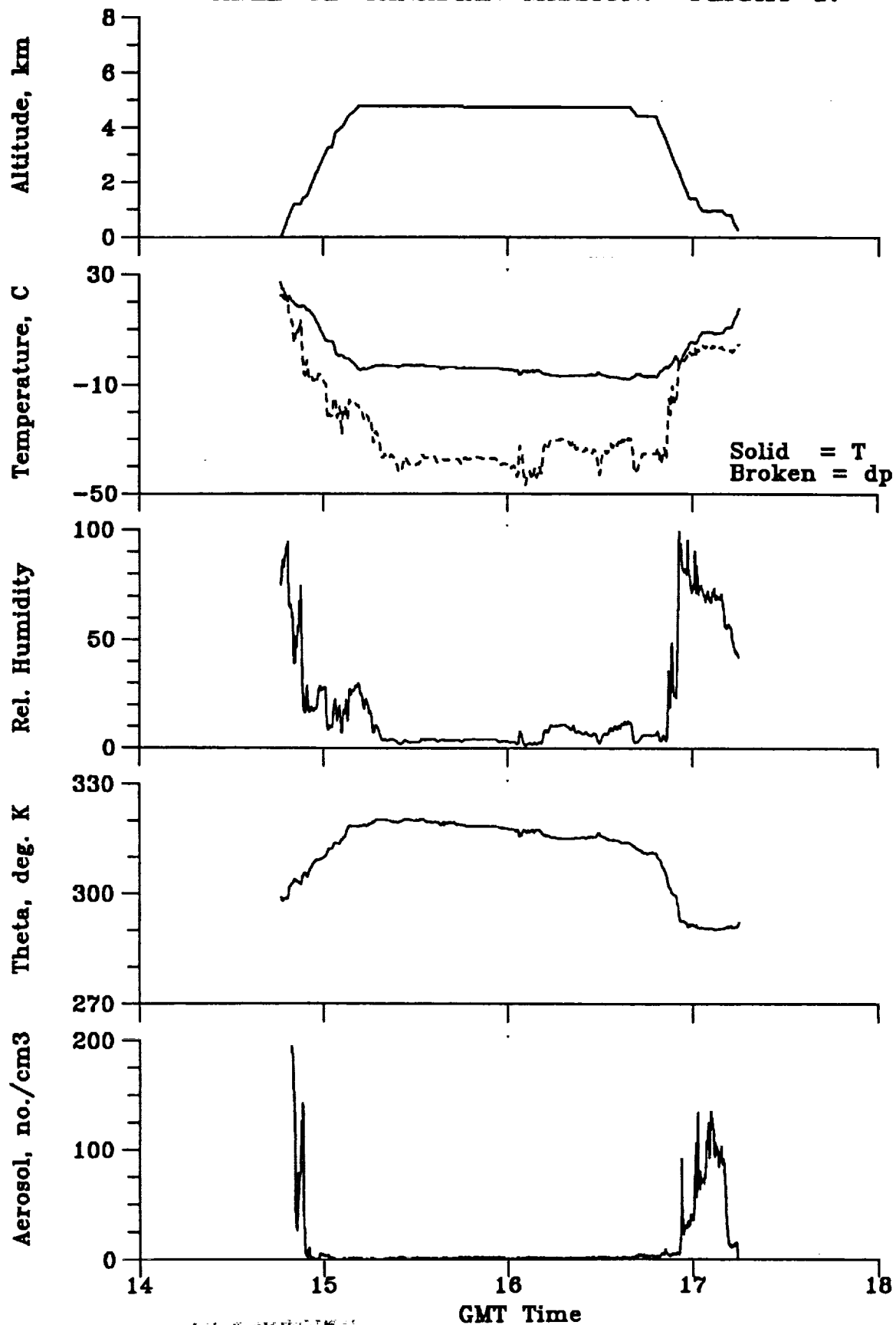


Figure B1.1

ABLE-3B CANADIAN MISSION: FLIGHT 1.

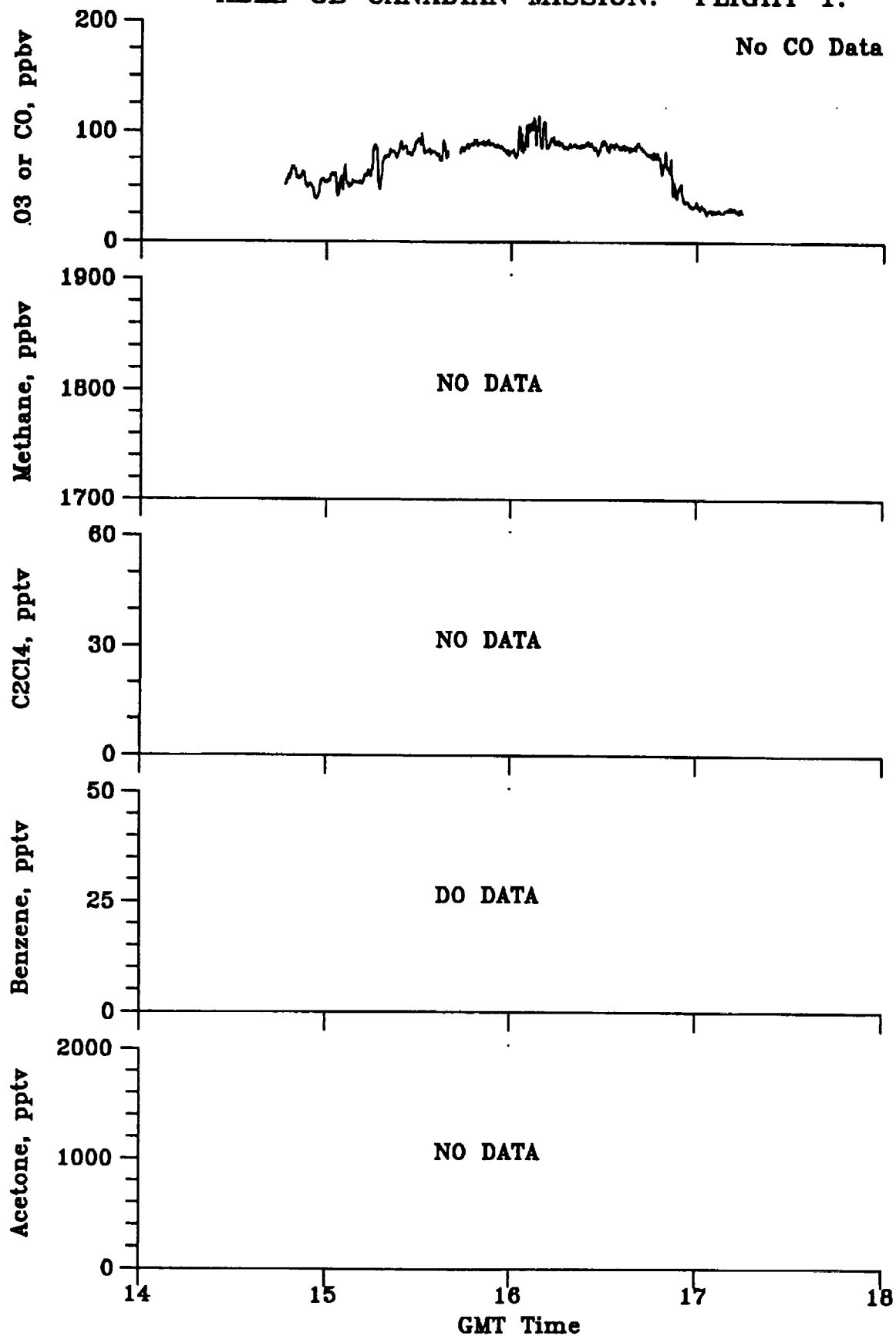


Figure B1.2

# ABLE-3B CANADIAN MISSION: FLIGHT 1.

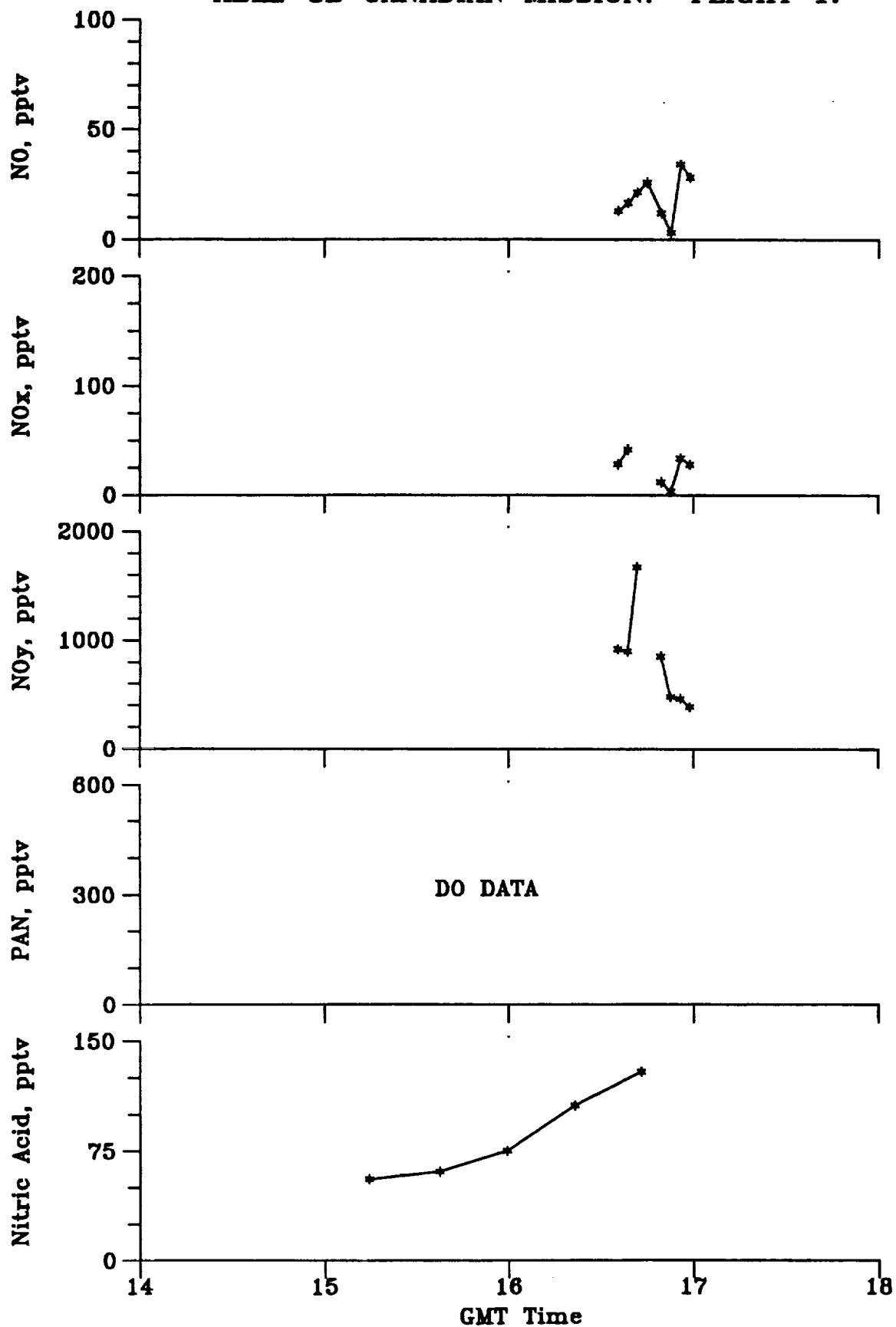


Figure B1.3

ABLE-3B CANADIAN MISSION: FLIGHT 1.

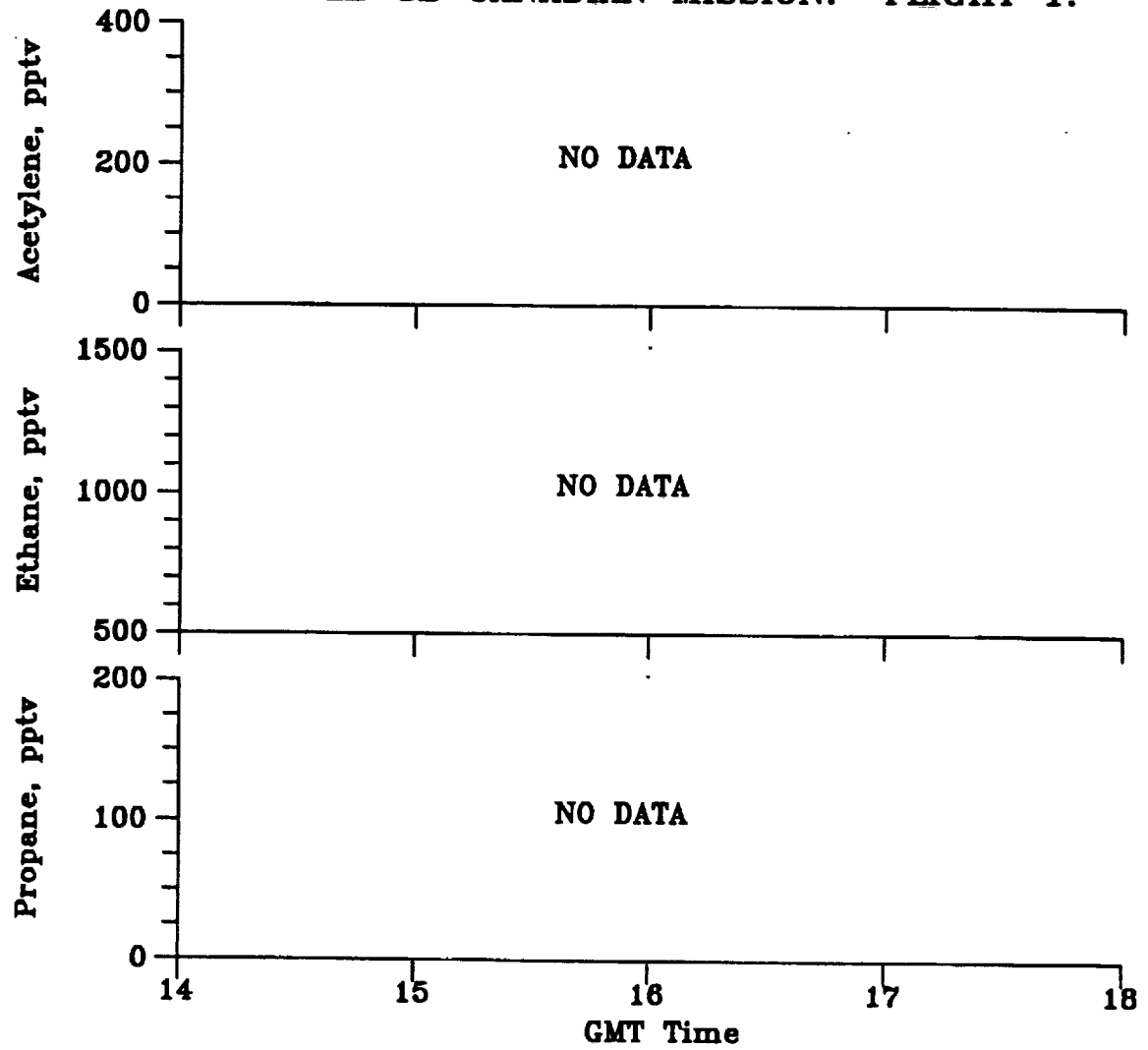
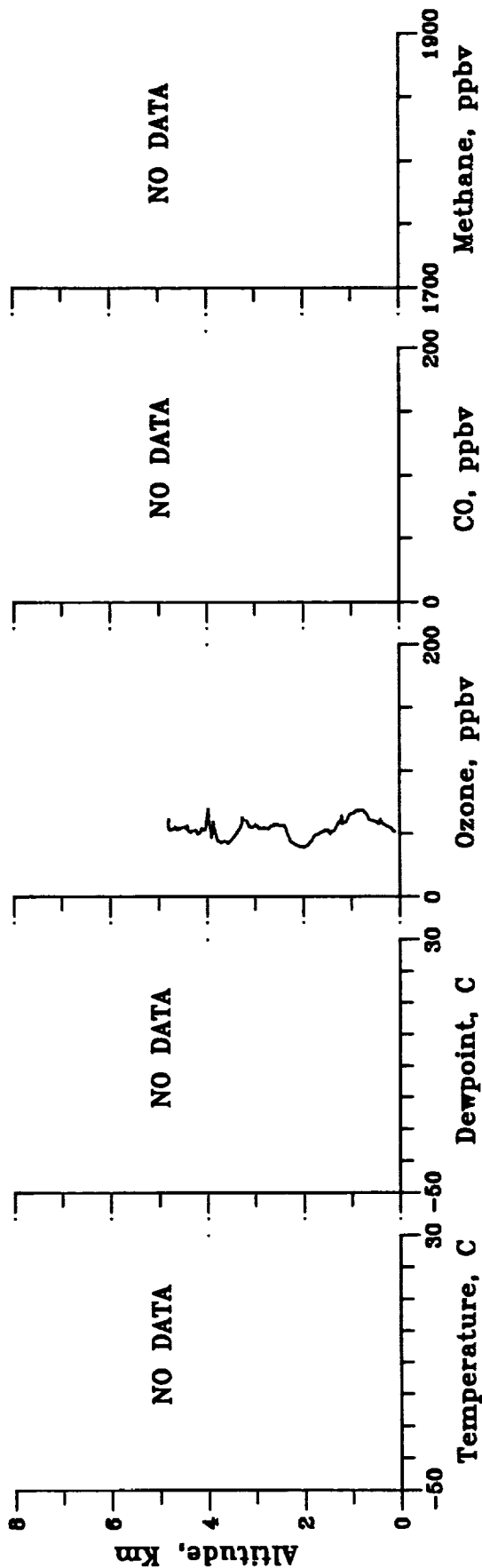


Figure B1.4

ABLE-3B CANADIAN MISSION: FLIGHT 1 PROFILE AT 1500 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 1 PROFILE AT 1700 GMT

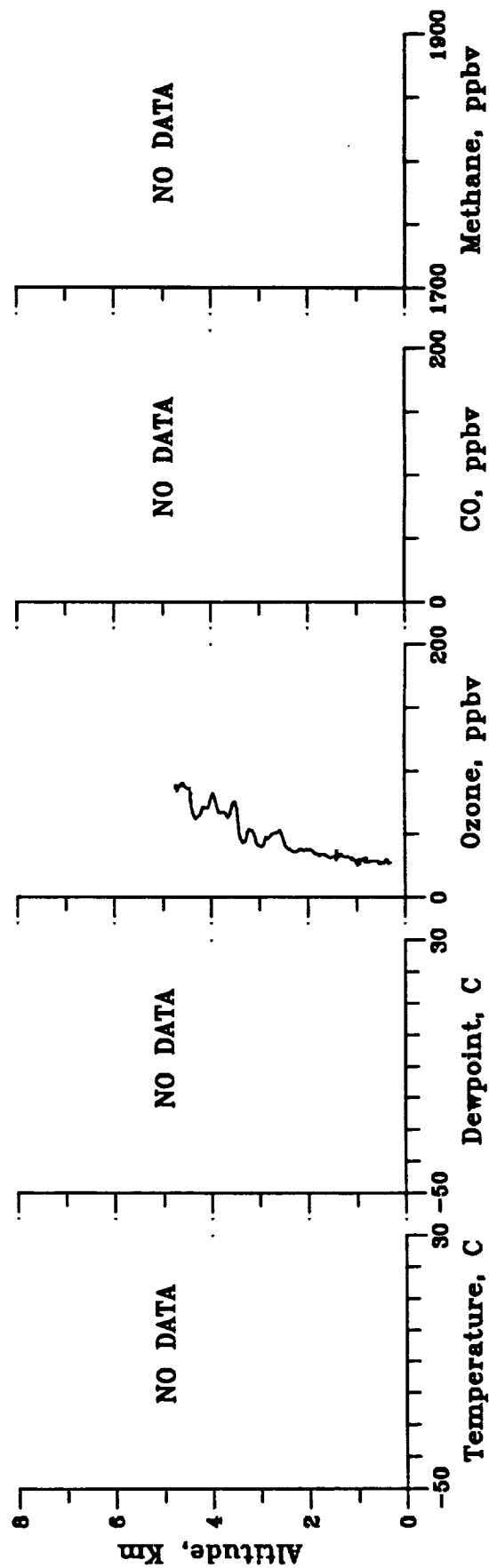


Figure B1.5

# ABLE-3B CANADIAN MISSION: FLIGHT 2.

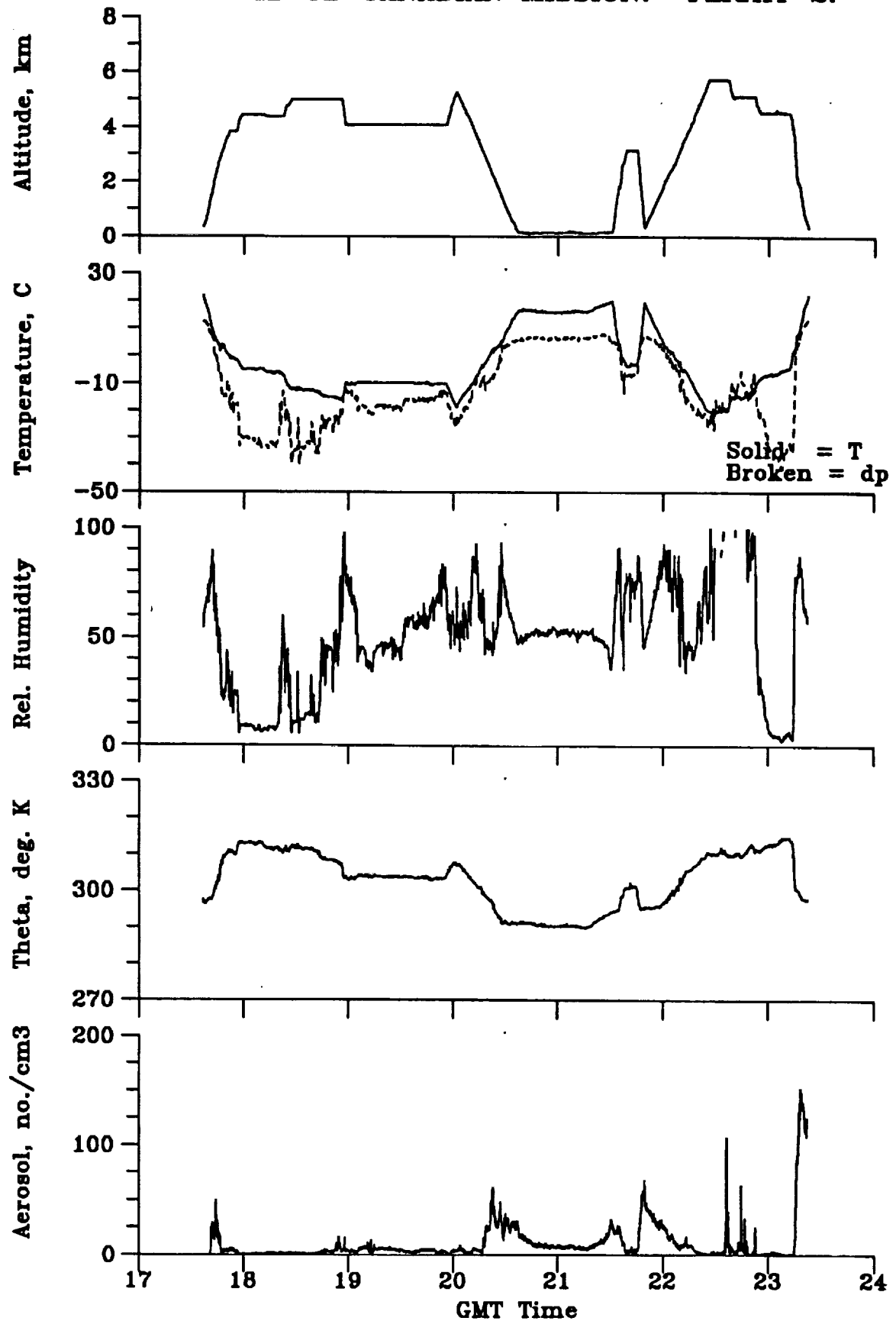


Figure B2.1

# ABLE-3B CANADIAN MISSION: FLIGHT 2.

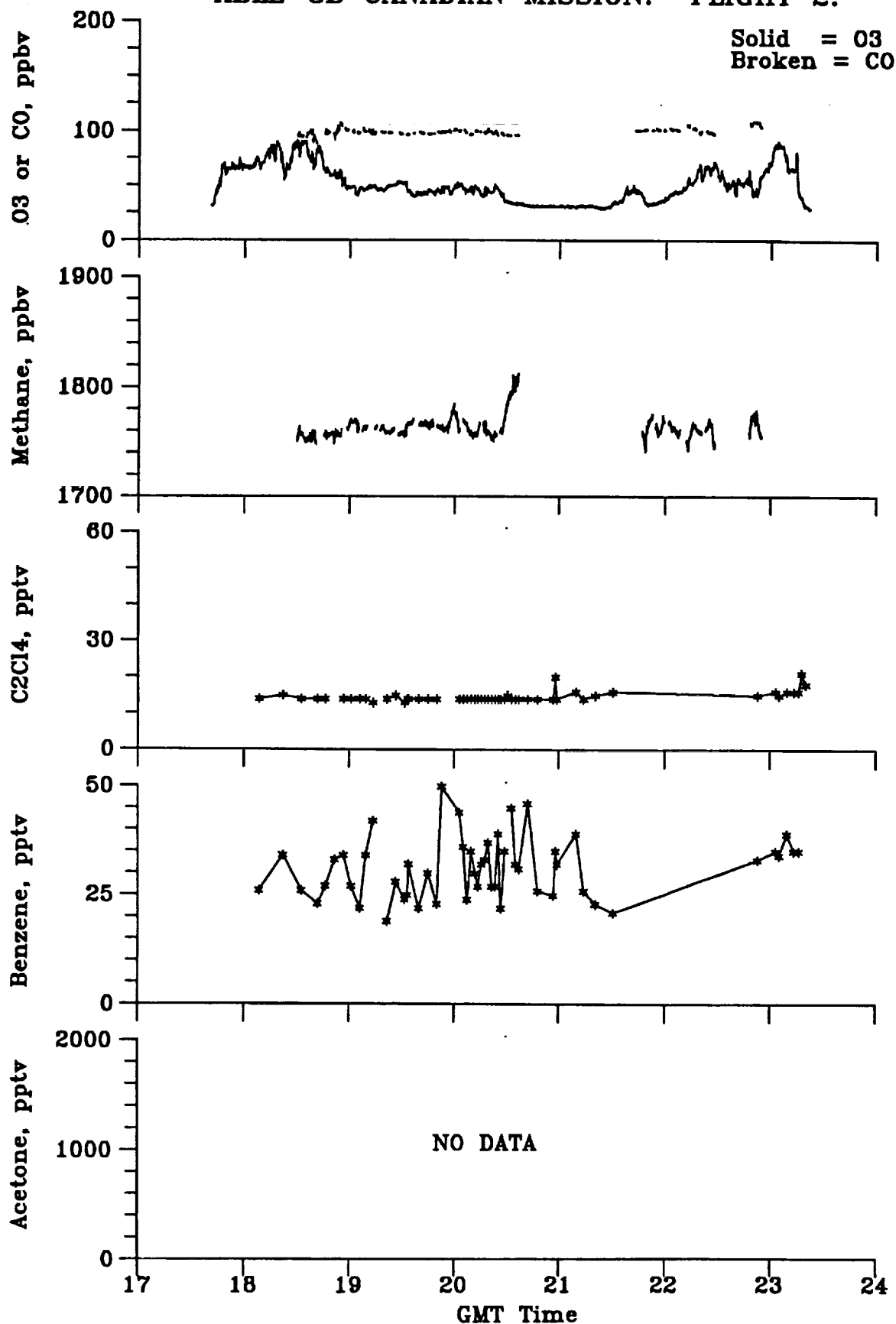


Figure B2.2



# ABLE-3B CANADIAN MISSION: FLIGHT 2.

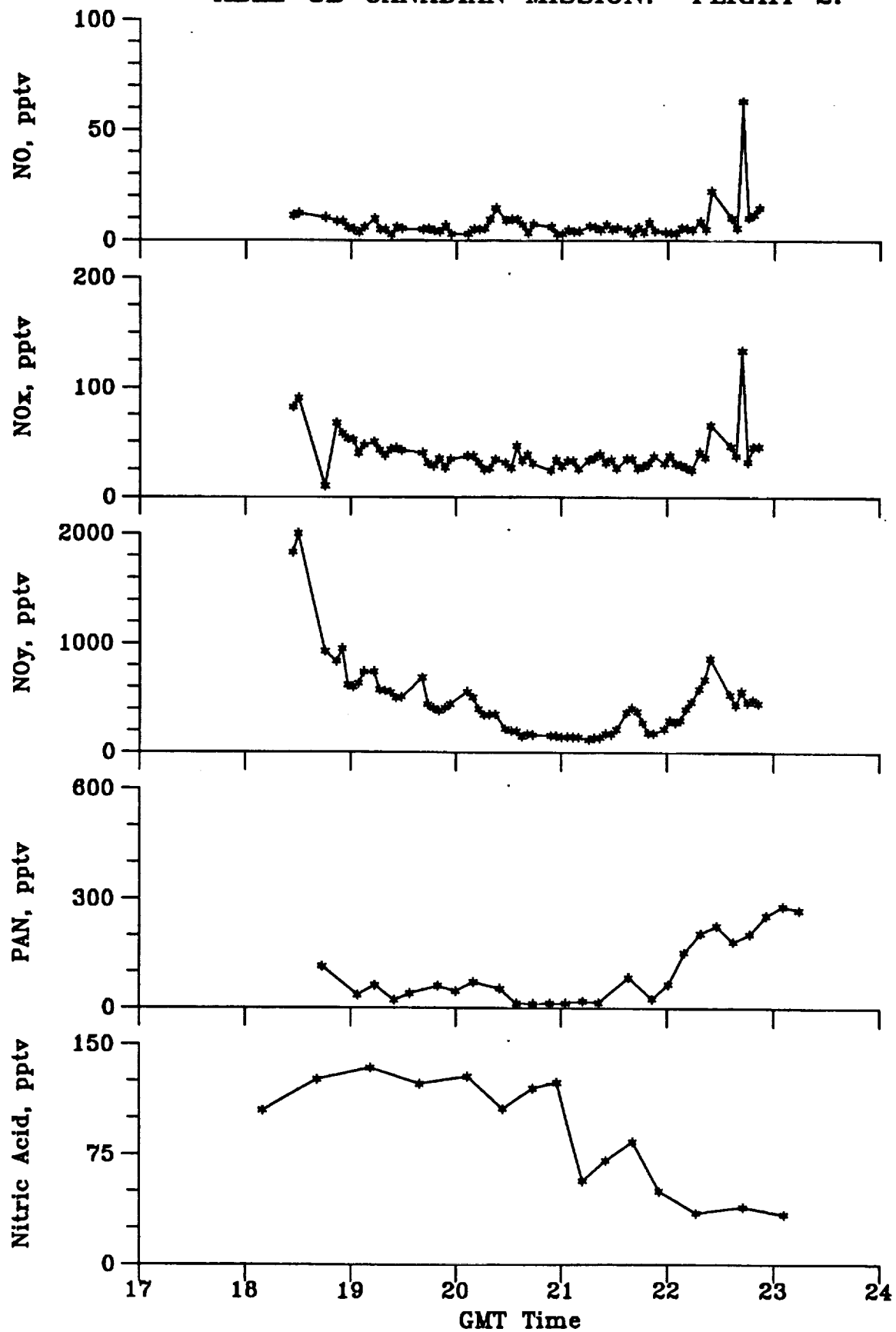


Figure B2.3

ABLE-3B CANADIAN MISSION: FLIGHT 2.

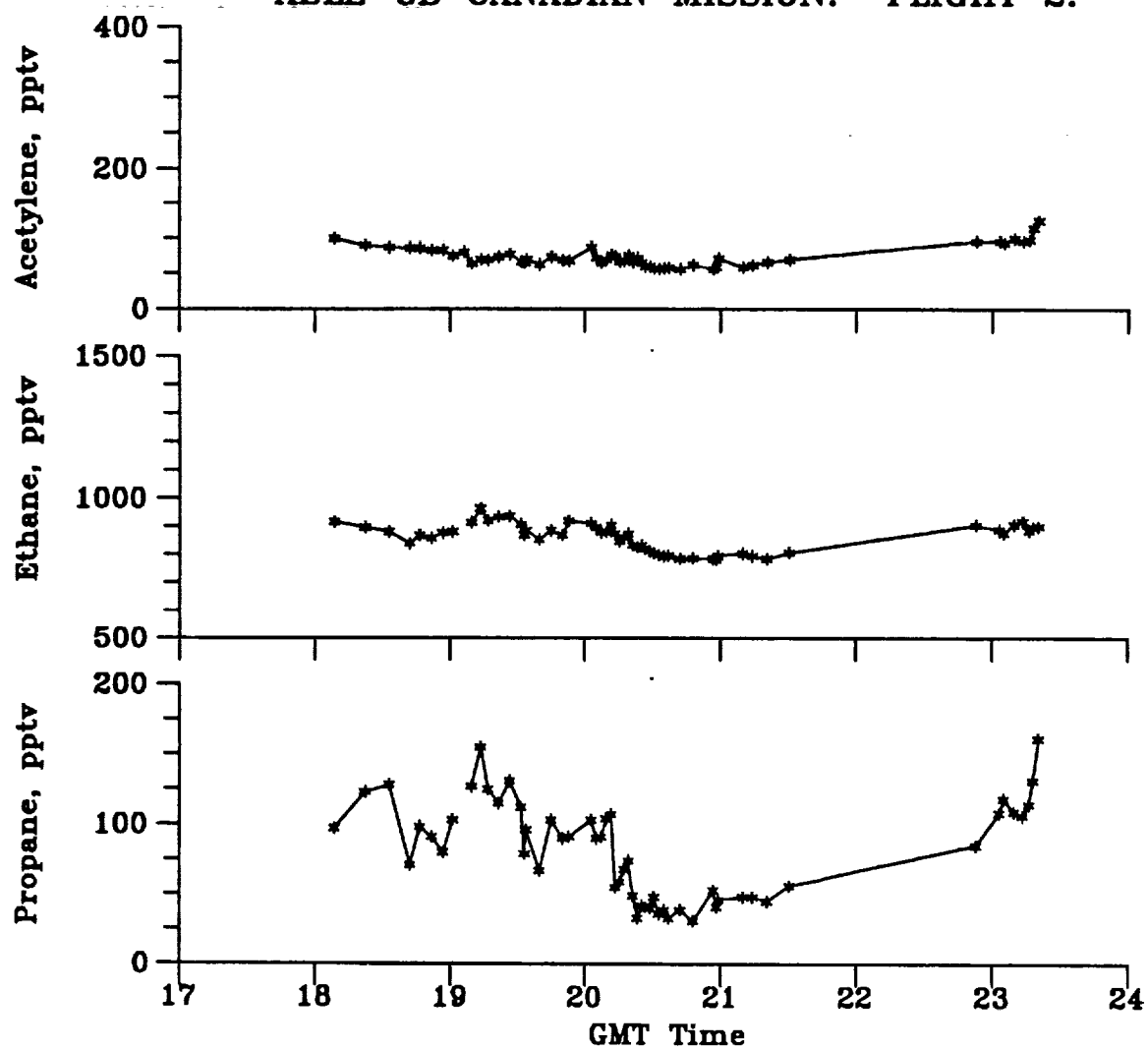
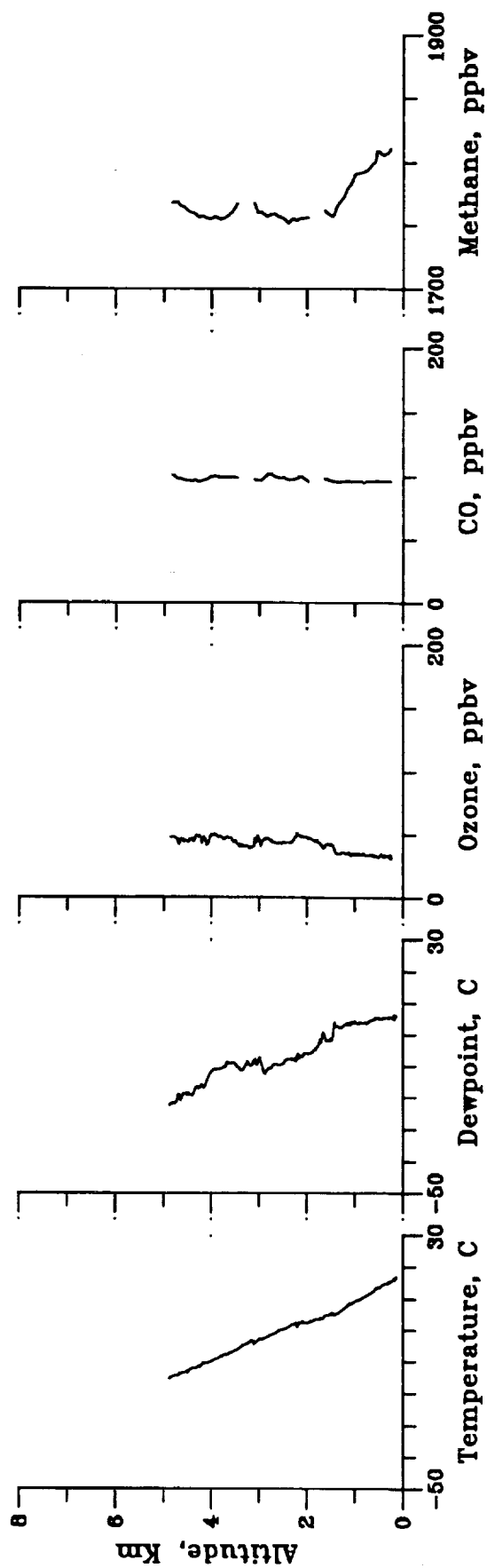


Figure B2.4

ABLE-3B CANADIAN MISSION: FLIGHT 2 PROFILE AT 2030 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 2 PROFILE AT 2200 GMT

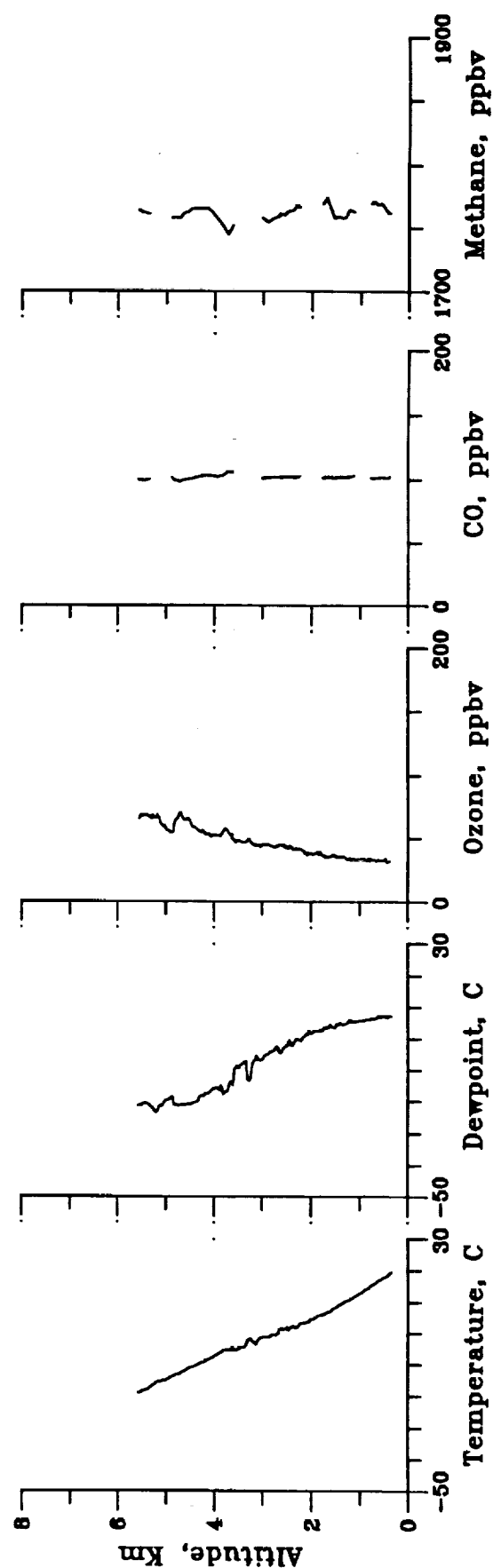


Figure B2.5

# ABLE-3B CANADIAN MISSION: FLIGHT 3.

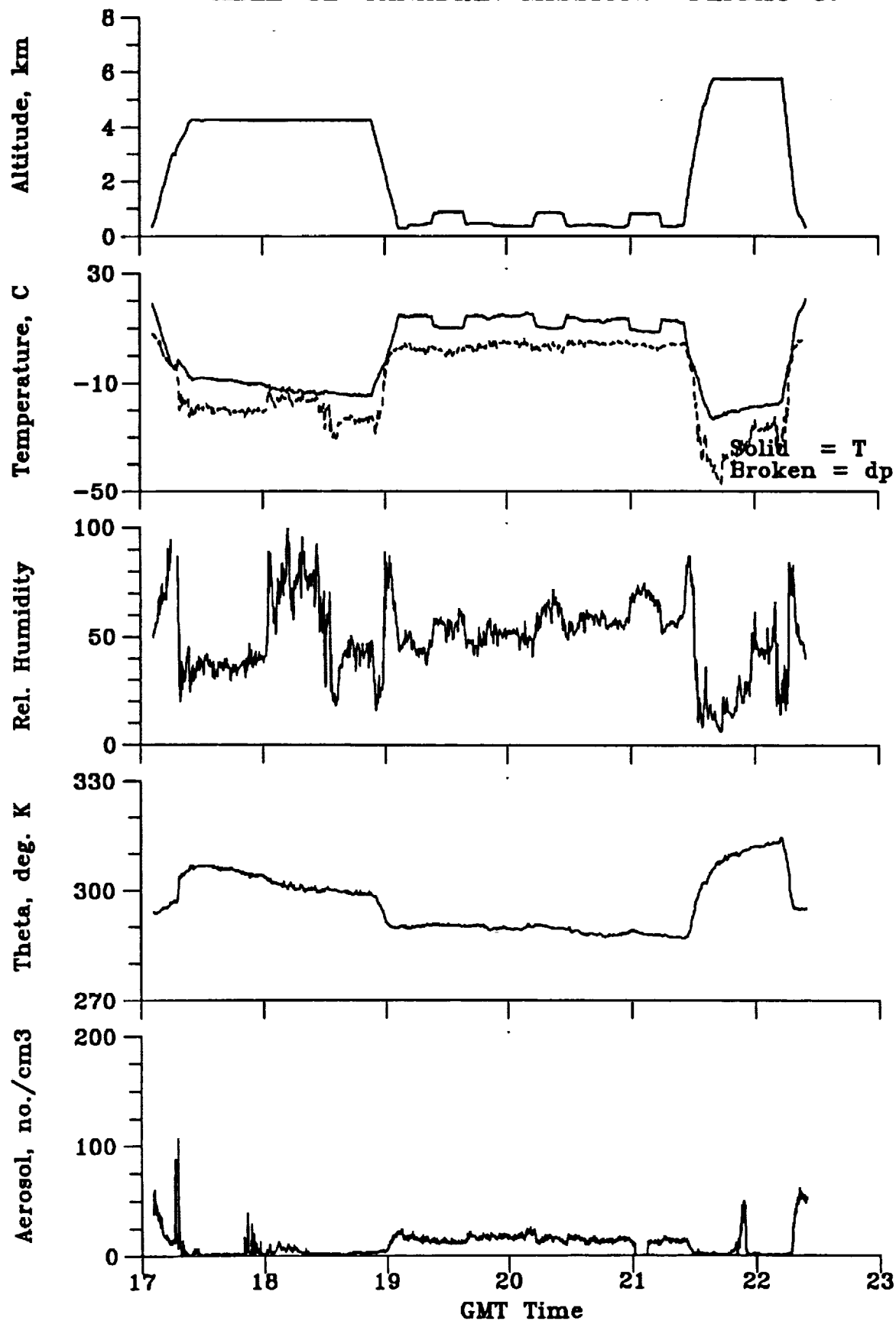


Figure B3.1

ABLE-3B CANADIAN MISSION: FLIGHT 3.

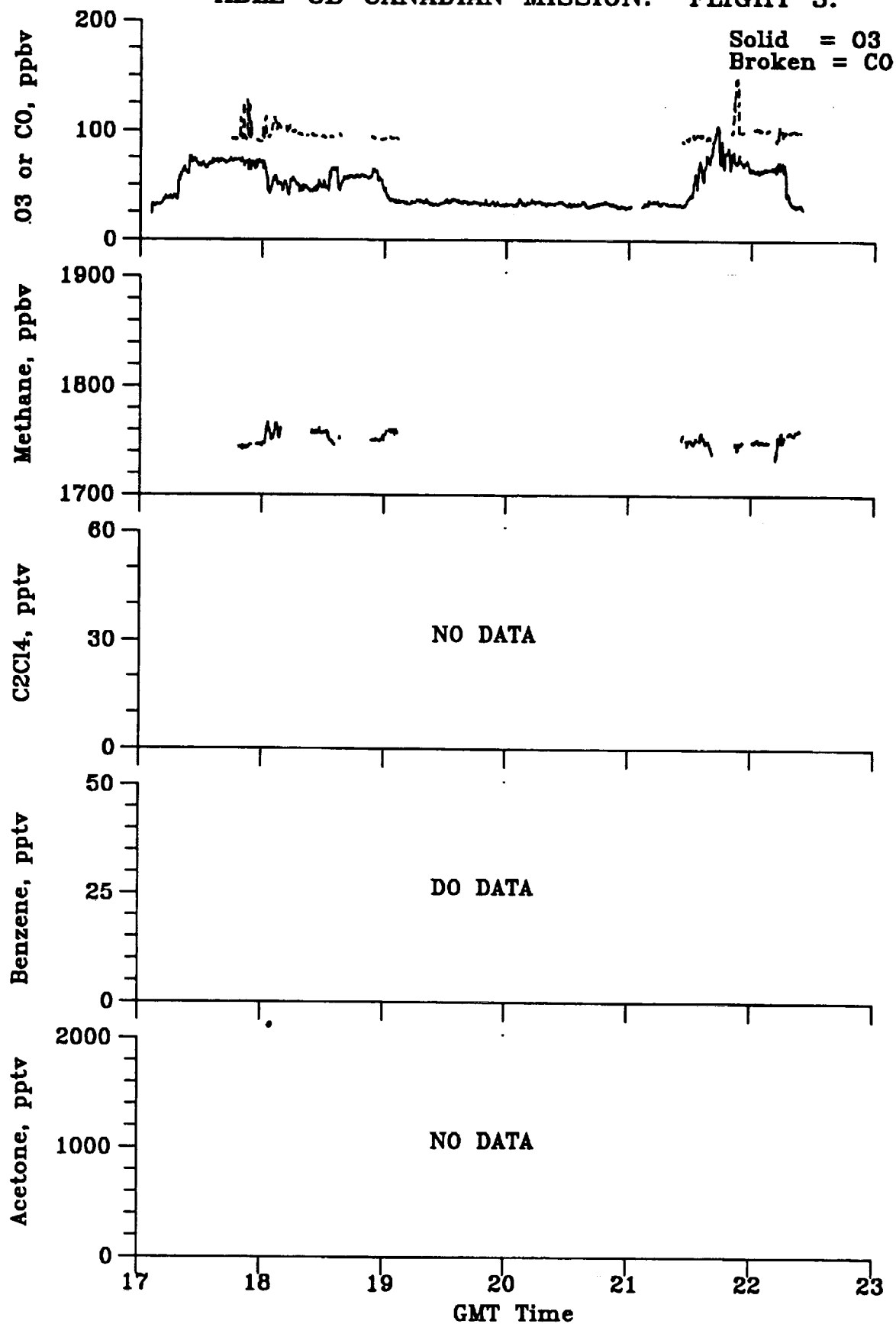


Figure B3.2

# ABLE-3B CANADIAN MISSION: FLIGHT 3.

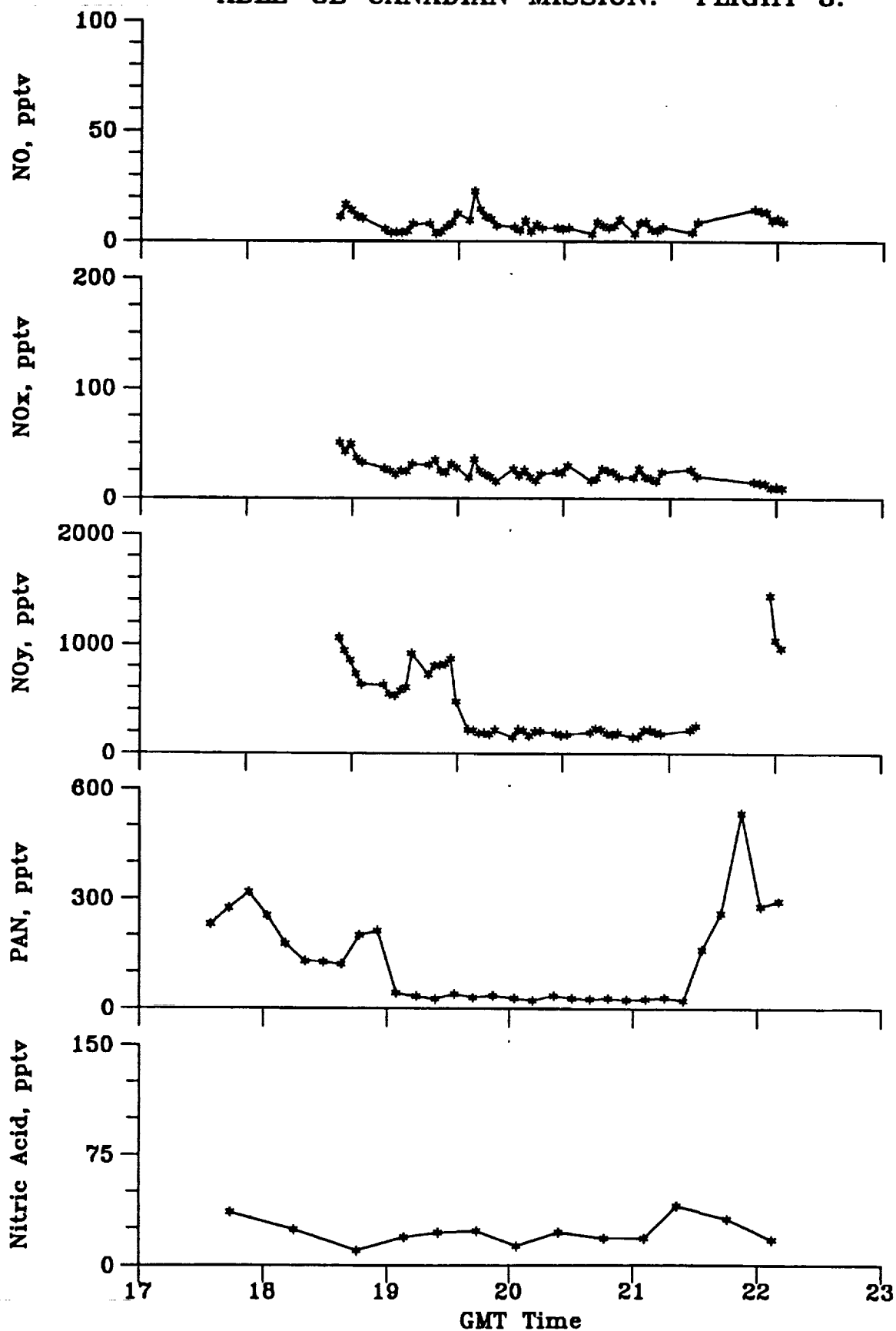


Figure B3.3

ABLE-3B CANADIAN MISSION: FLIGHT 3.

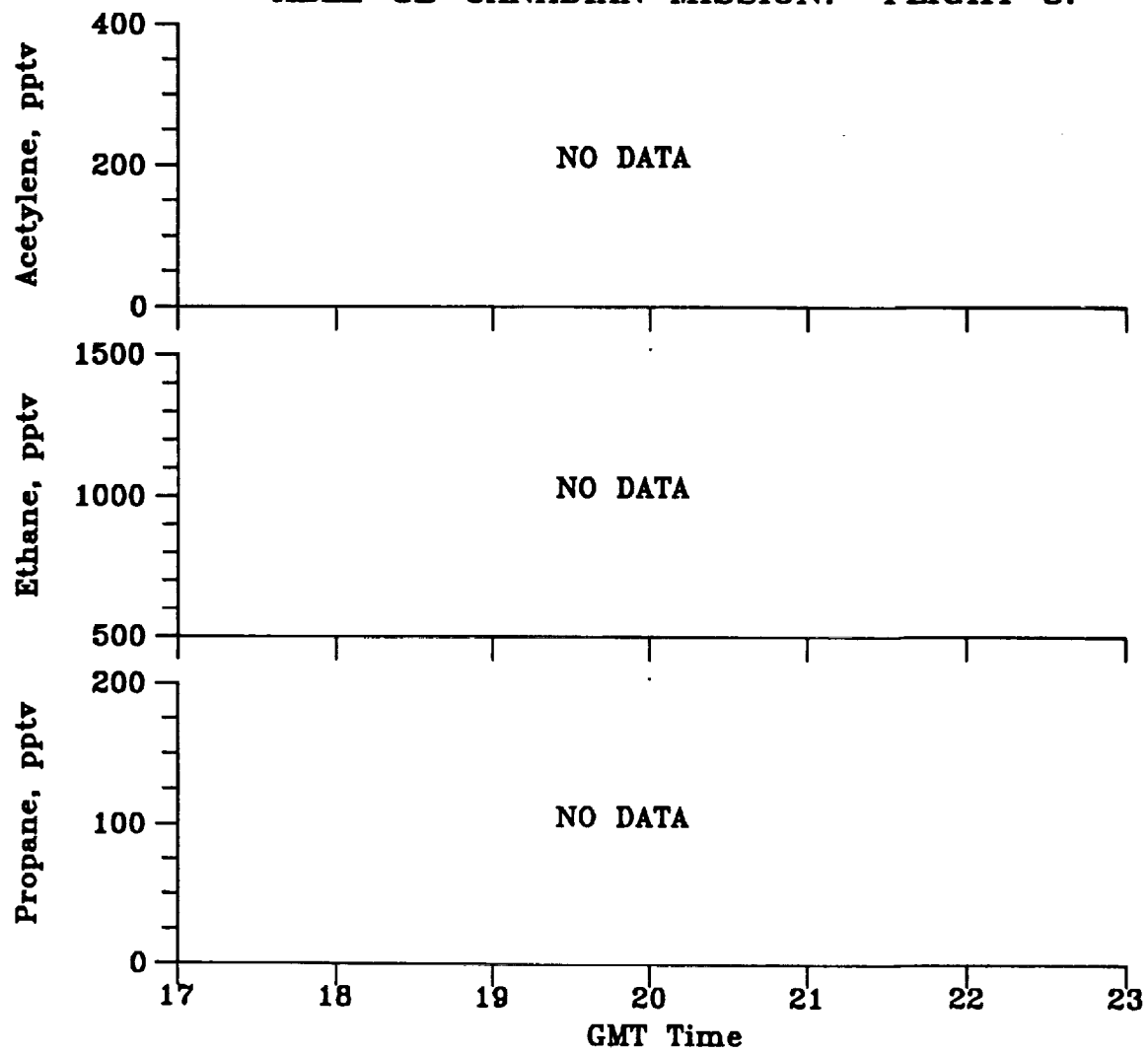
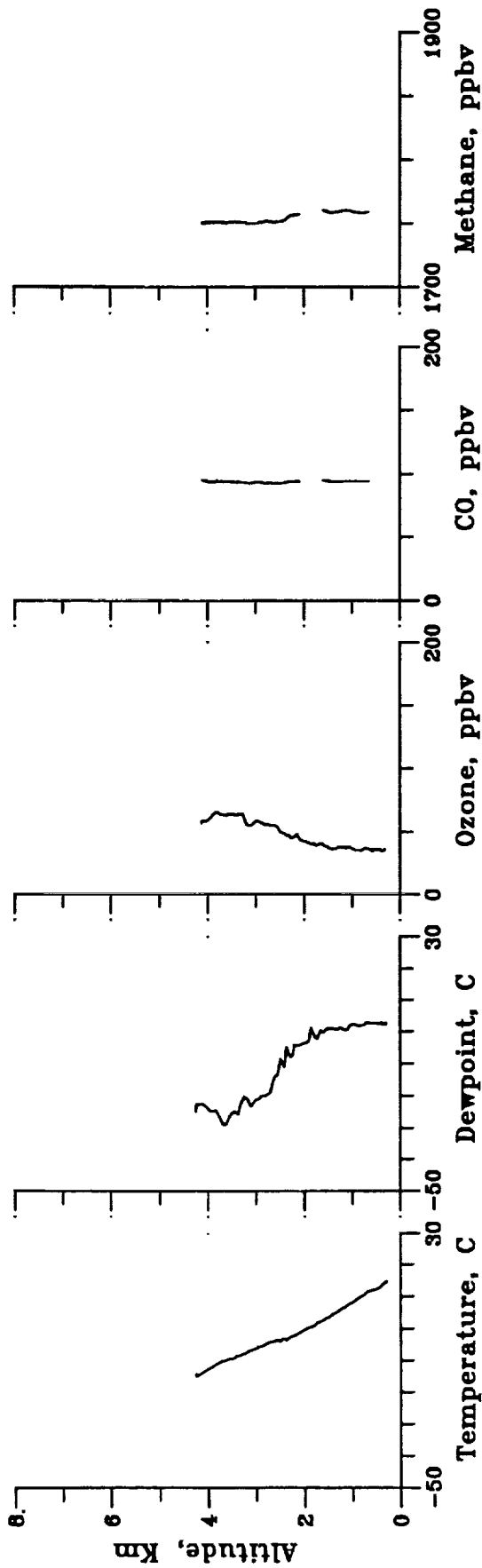


Figure B3.4

ABLE-3B CANADIAN MISSION: FLIGHT 3 PROFILE AT 1900 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 3 PROFILE AT 2130 GMT

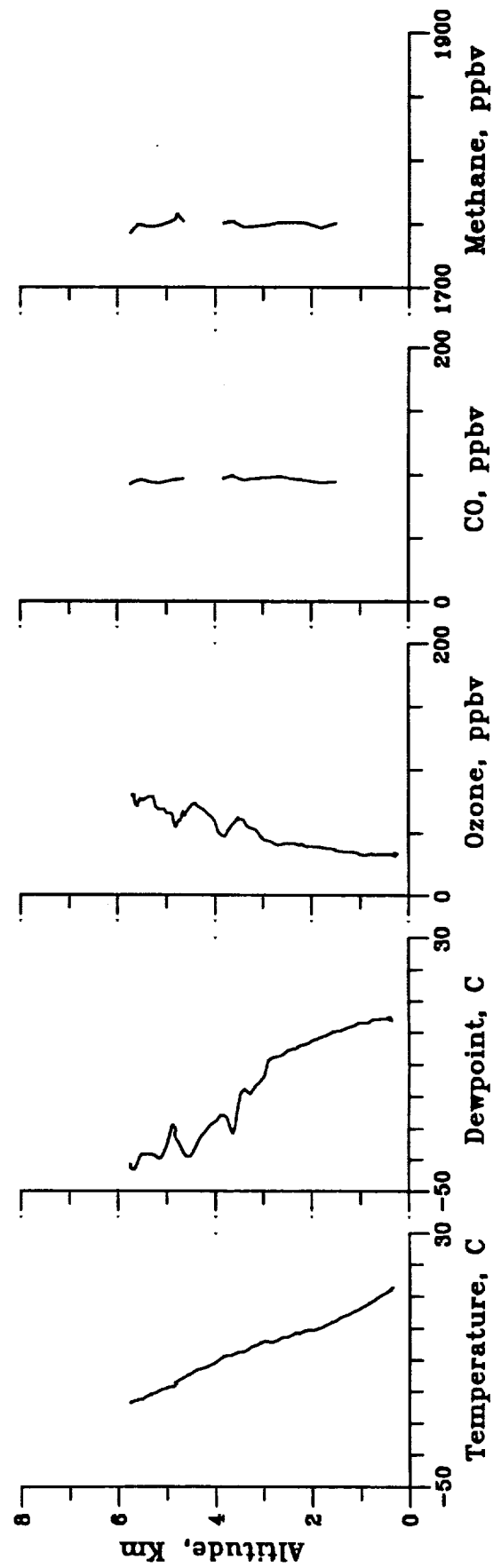


Figure B3.5



# ABLE-3B CANADIAN MISSION: FLIGHT 4.

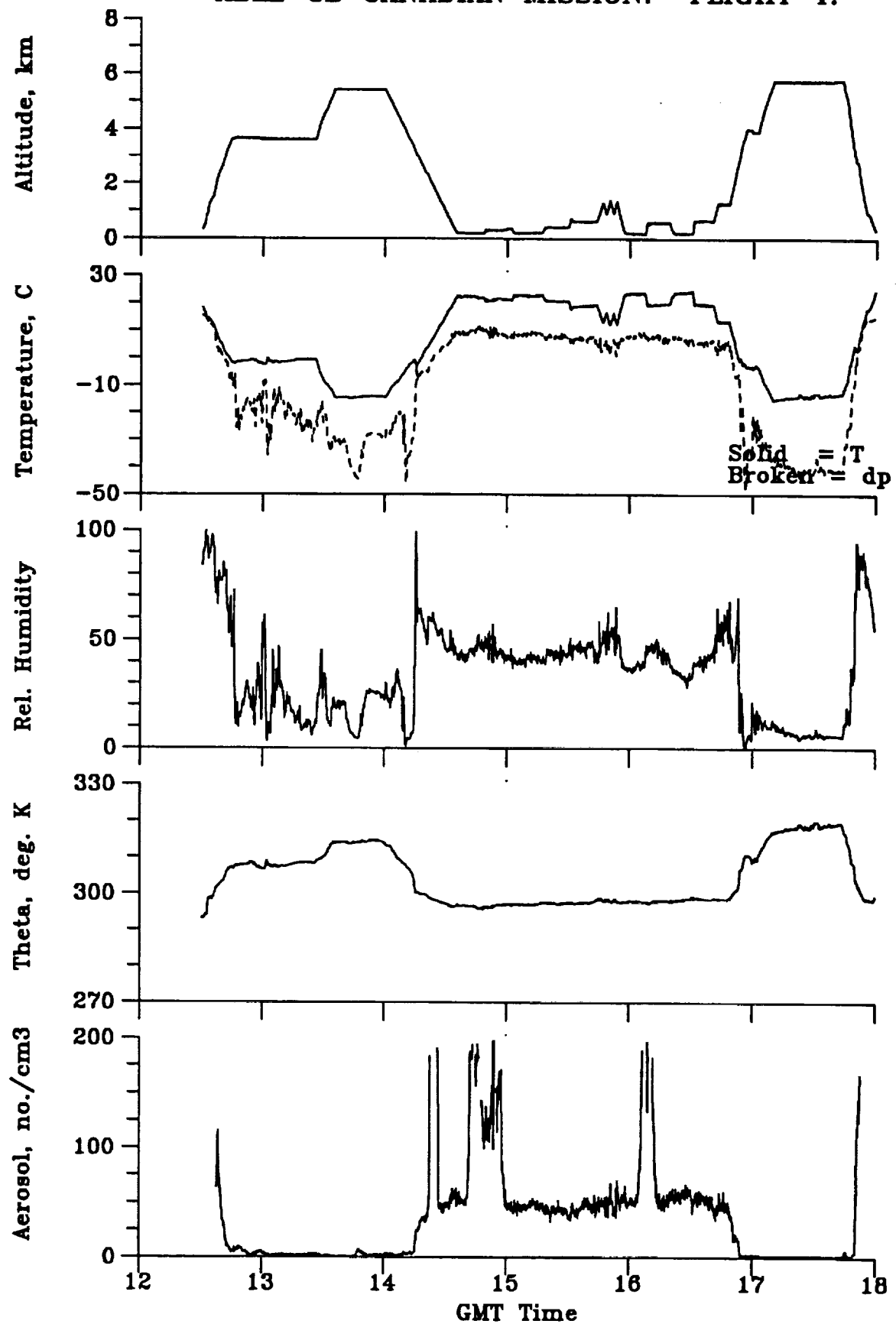


Figure B4.1

# ABLE-3B CANADIAN MISSION: FLIGHT 4.

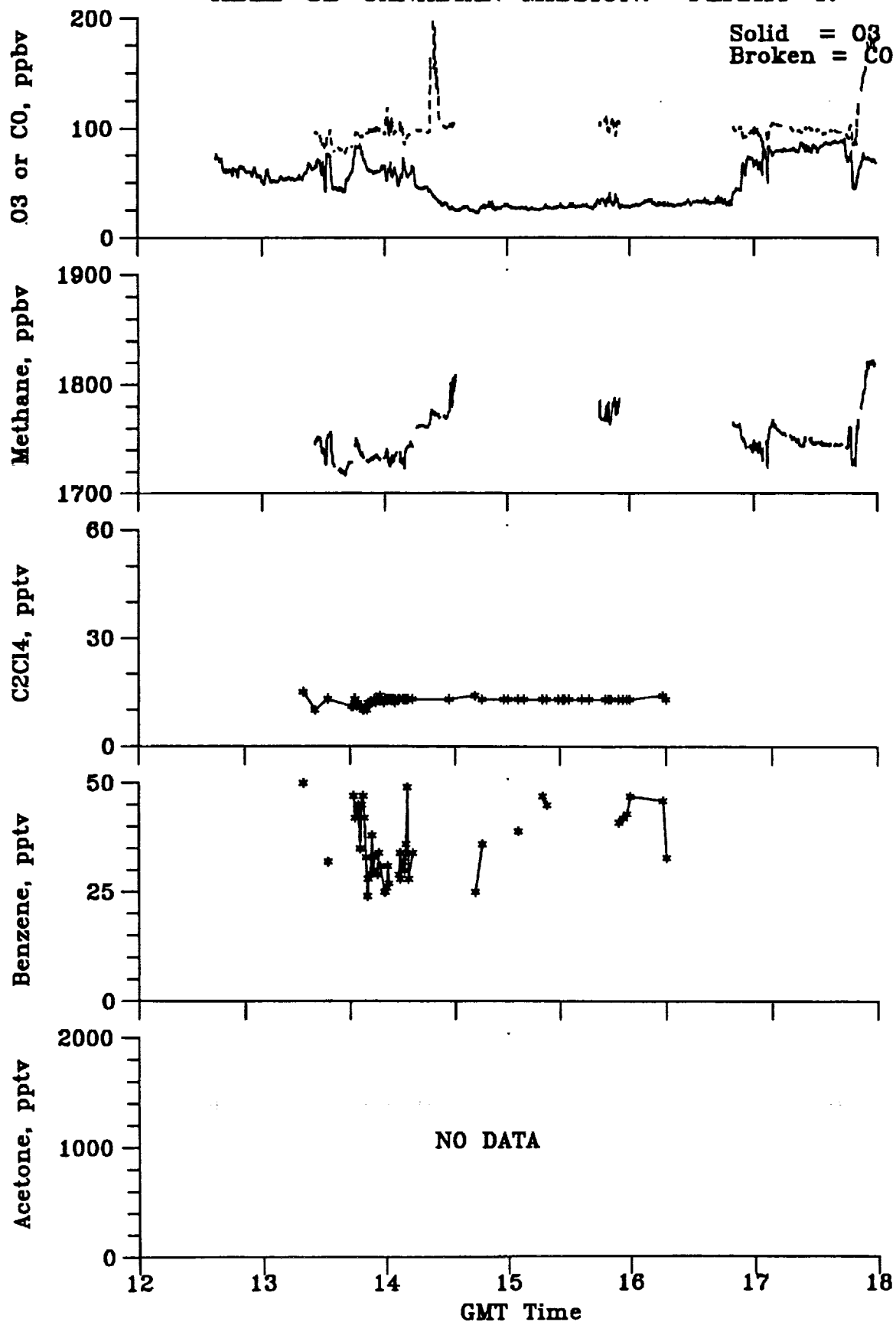


Figure B4.2

# ABLE-3B CANADIAN MISSION: FLIGHT 4.

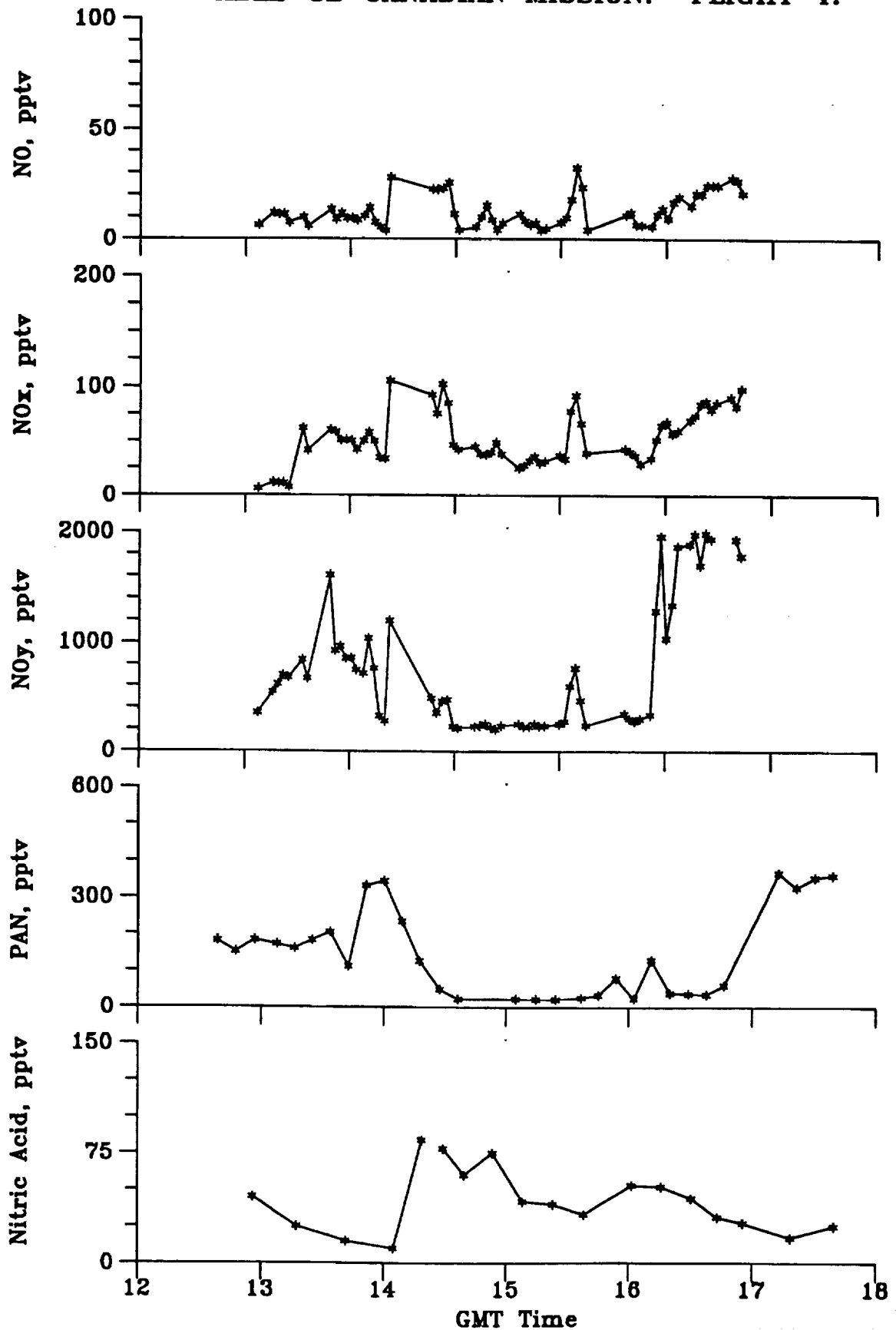


Figure B4.3

ABLE-3B CANADIAN MISSION: FLIGHT 4.

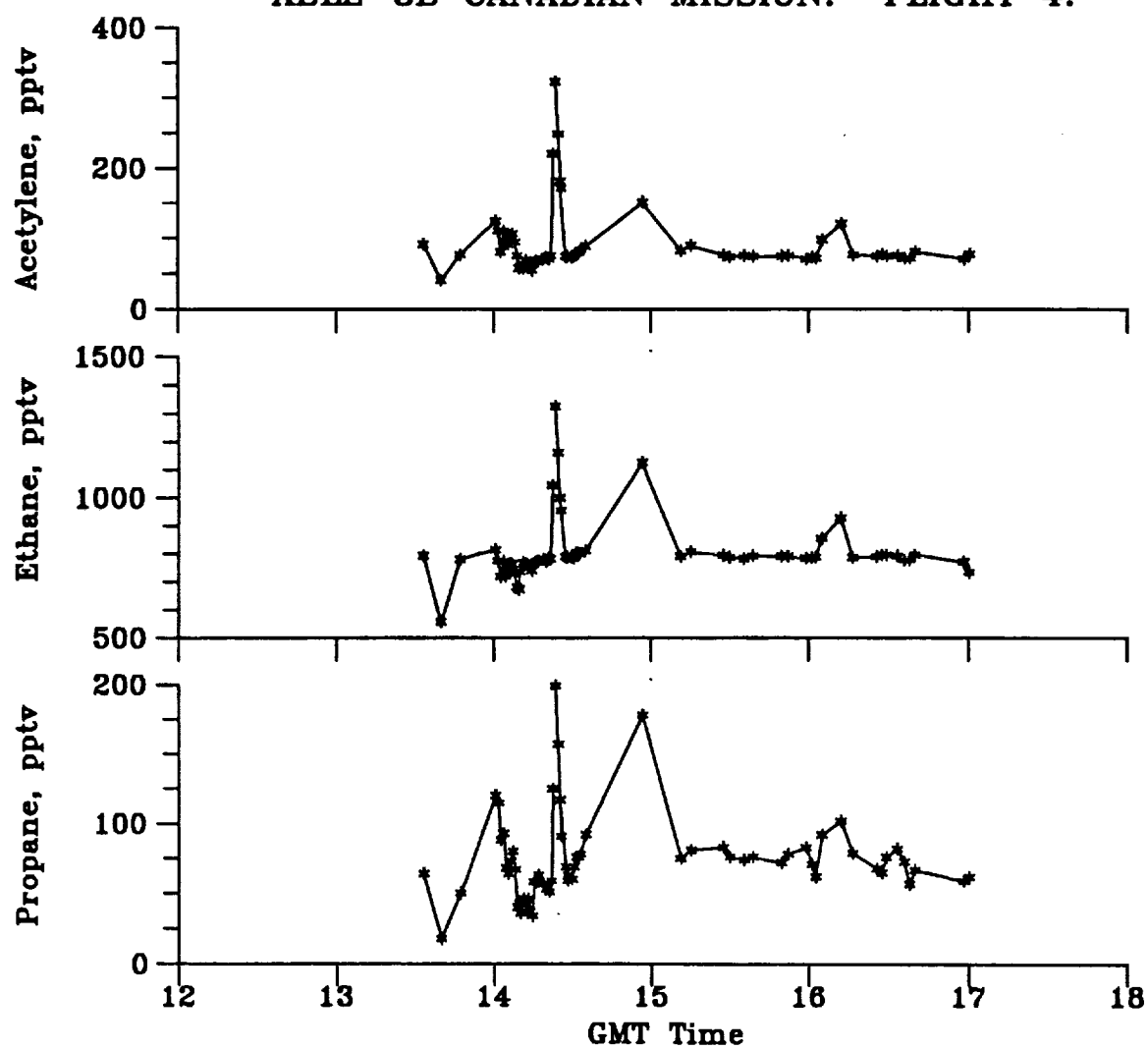
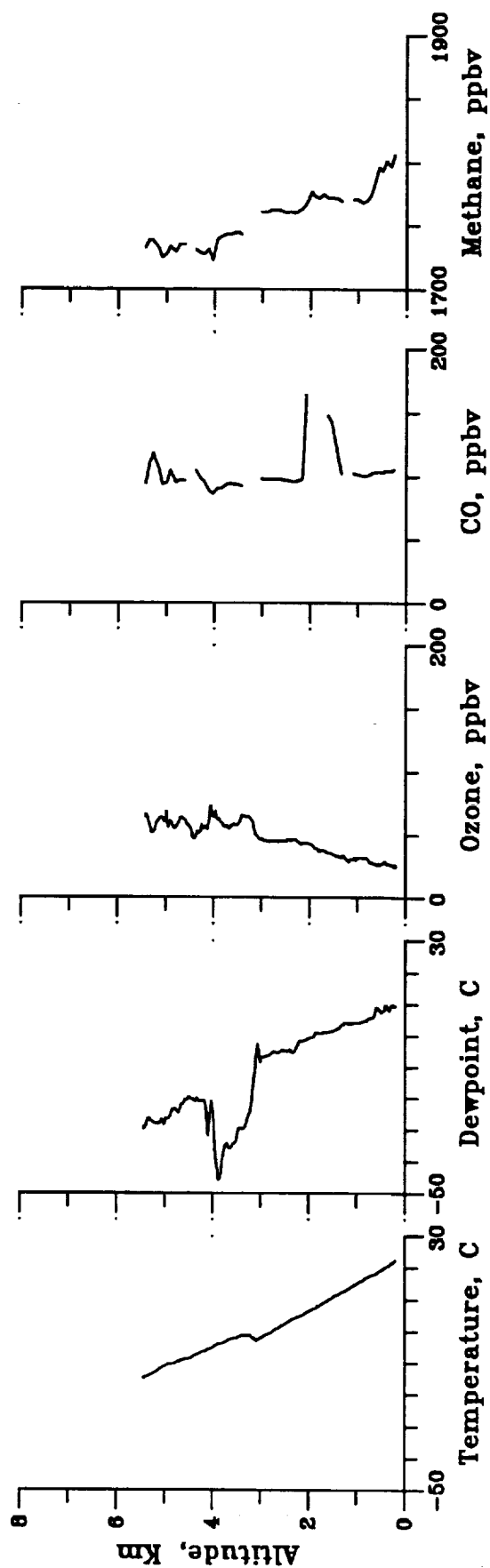


Figure B4.4

ABLE-3B CANADIAN MISSION: FLIGHT 4 PROFILE AT 1415 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 4 PROFILE AT 1645 GMT

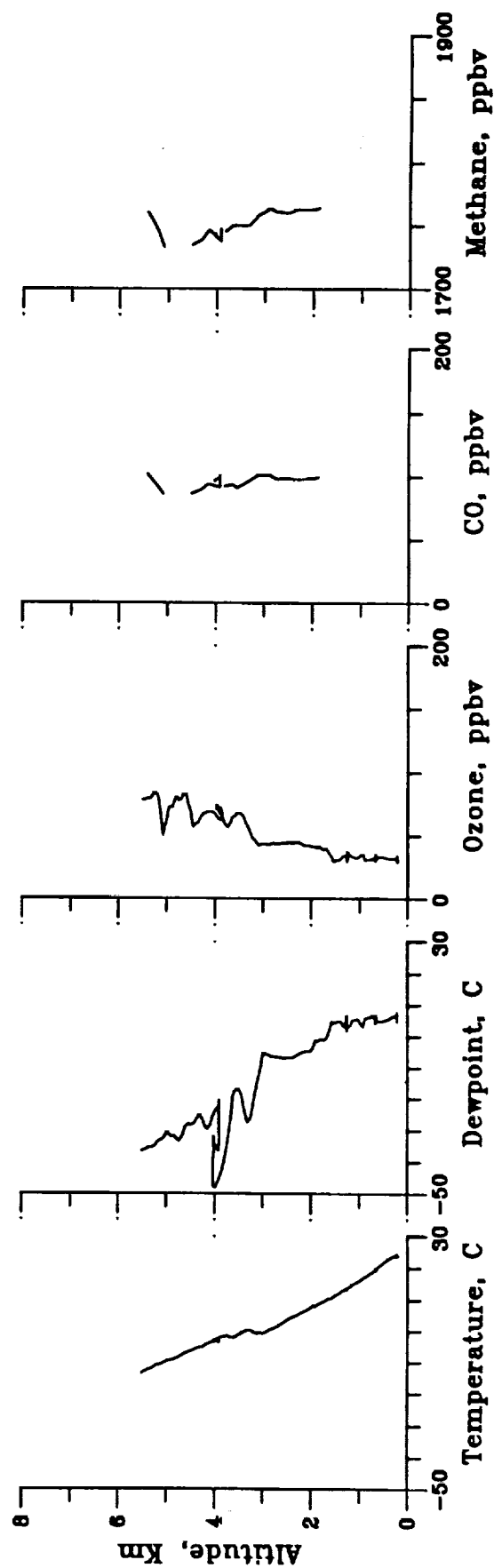


Figure B4.5

ABLE-3B CANADIAN MISSION: FLIGHT 5.

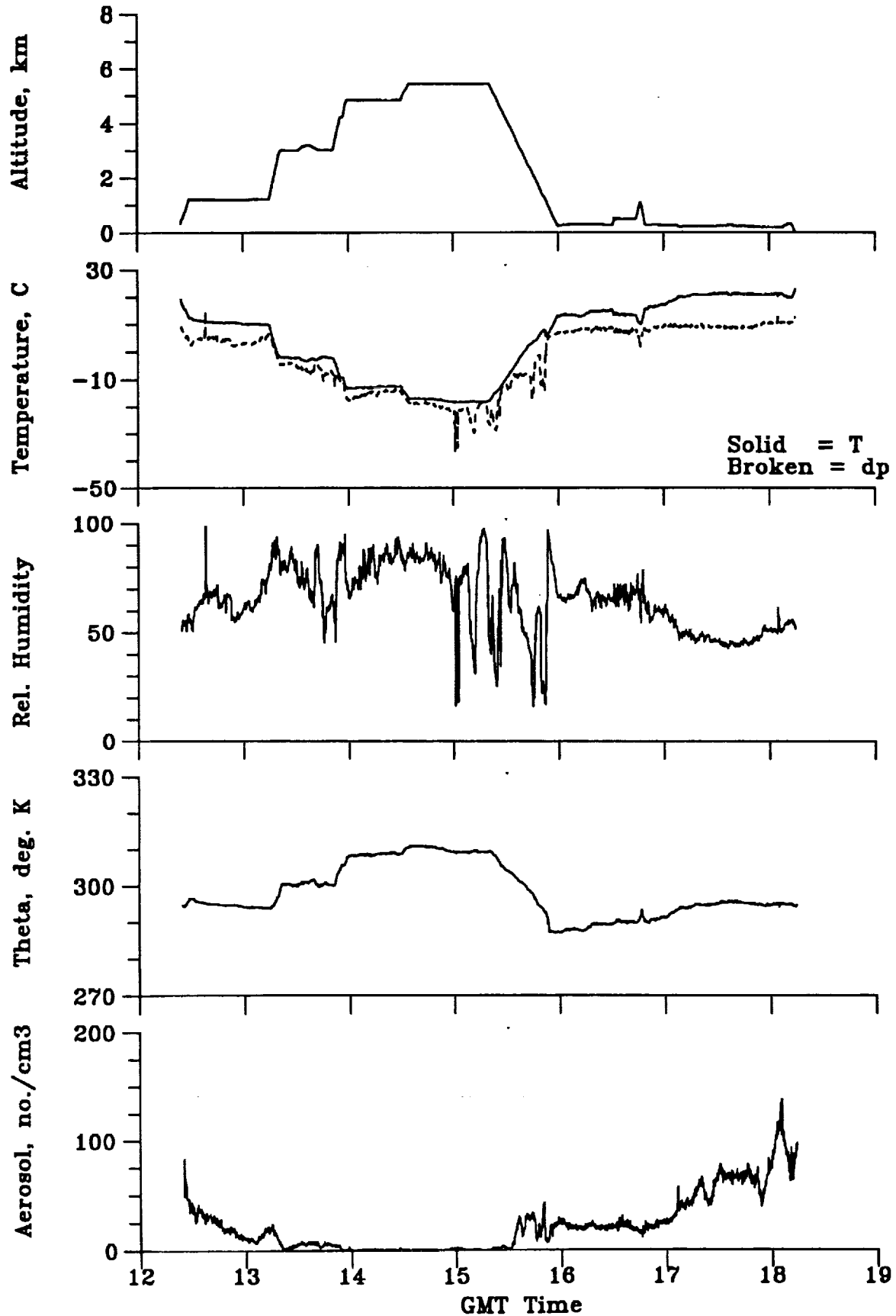


Figure B5.1

# ABLE-3B CANADIAN MISSION: FLIGHT 5.

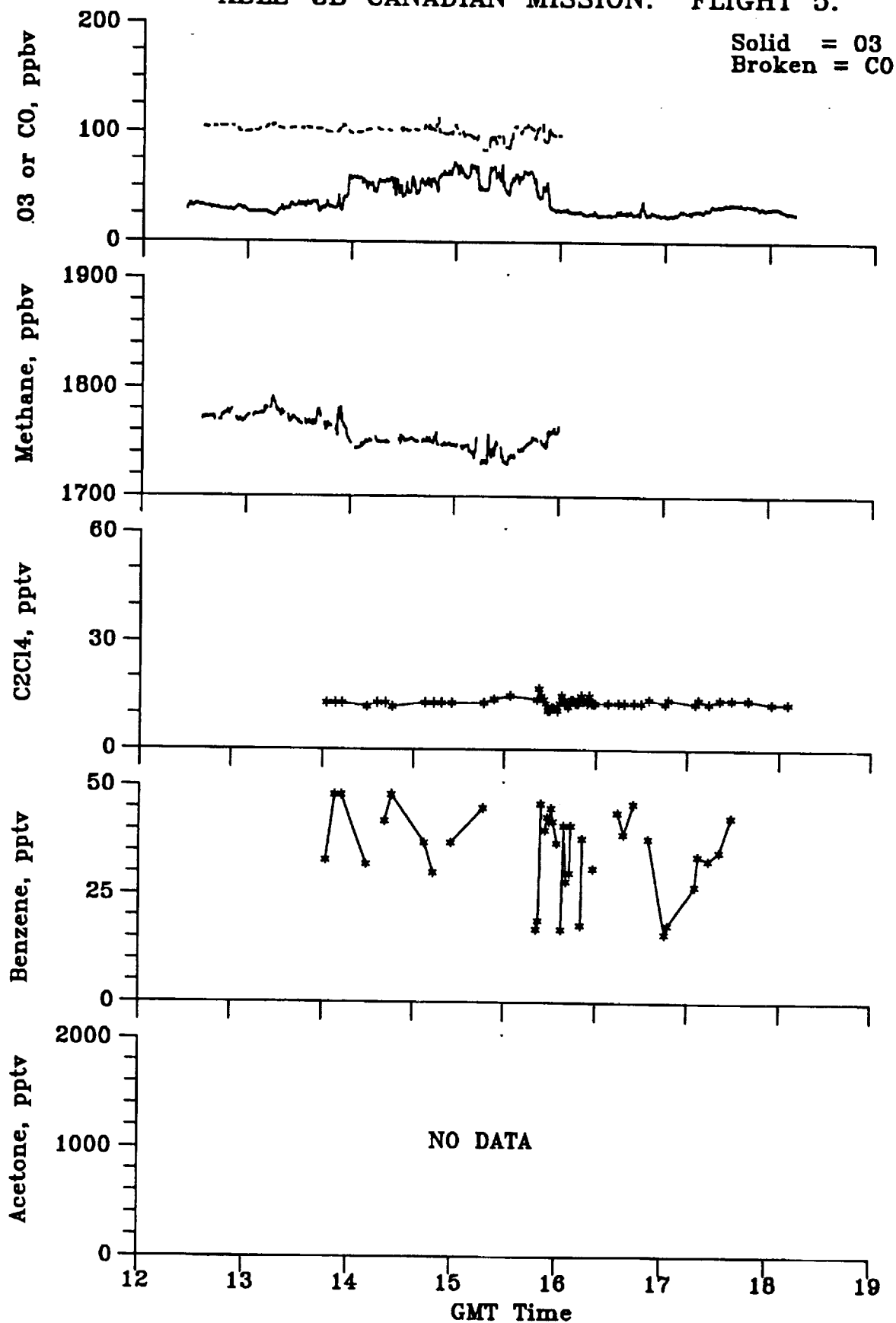


Figure B5.2

ABLE-3B CANADIAN MISSION: FLIGHT 5.

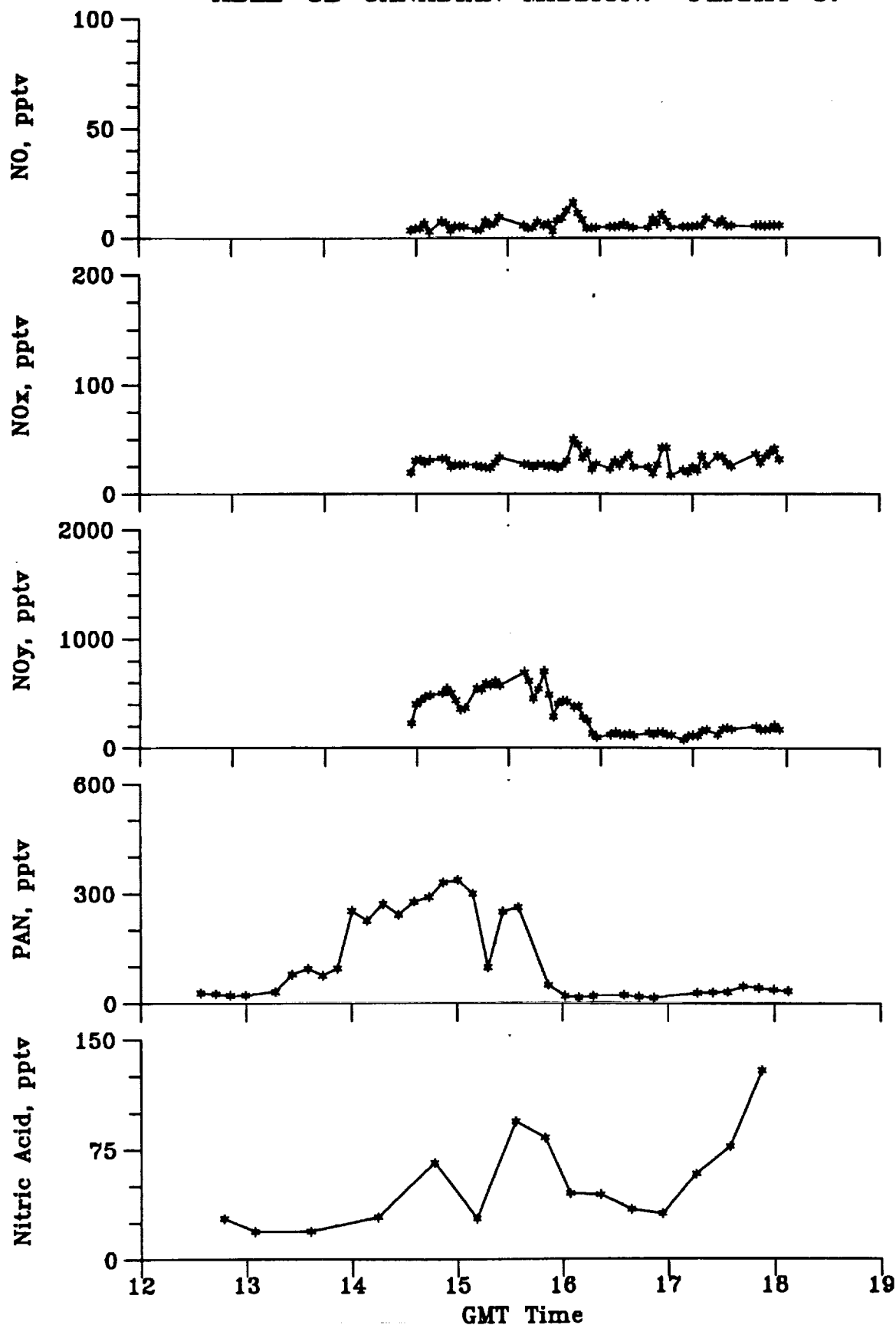


Figure B5.3



ABLE-3B CANADIAN MISSION: FLIGHT 5.

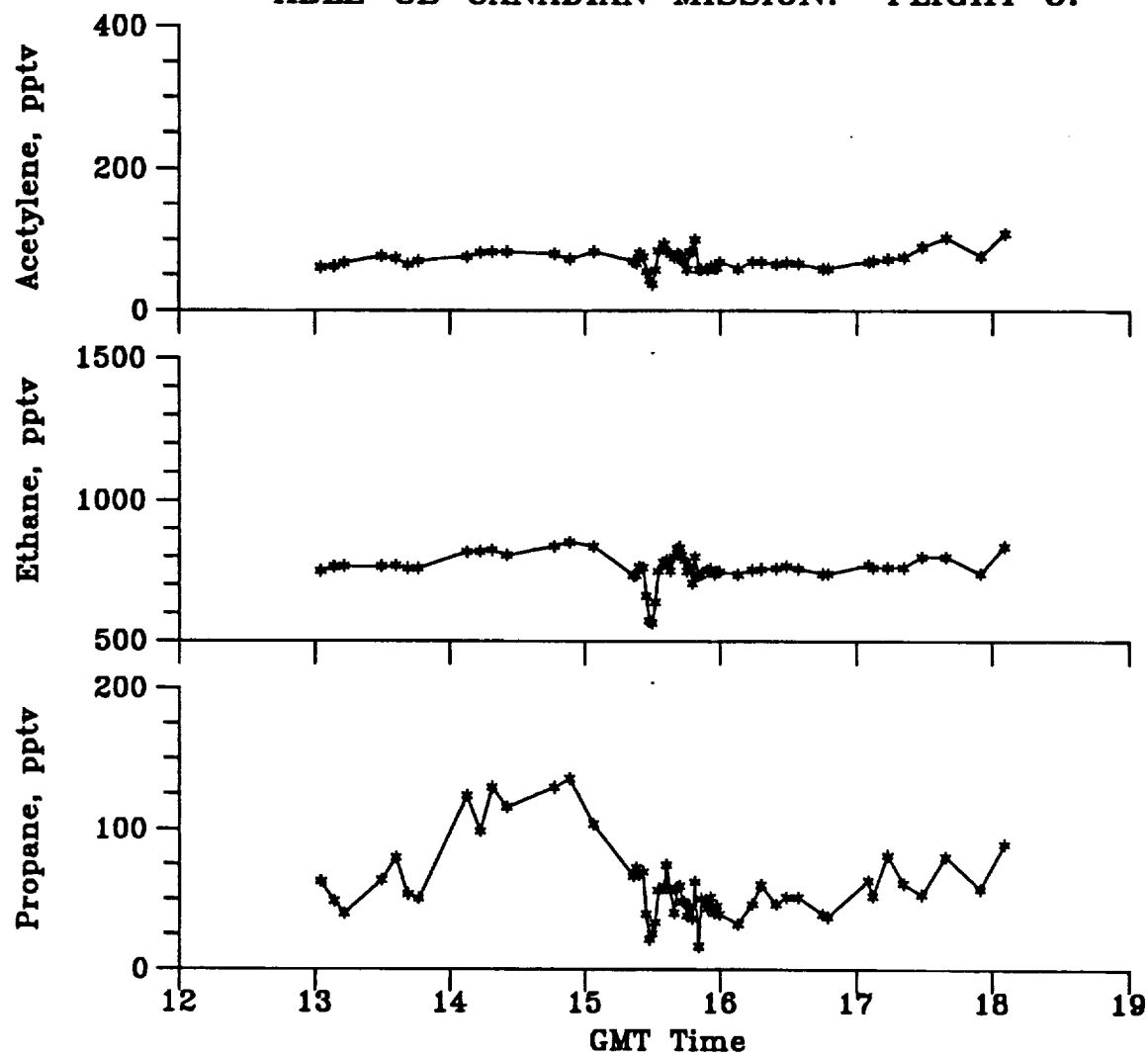


Figure B5.4

ABLE-3B CANADIAN MISSION: FLIGHT 5 PROFILE AT 1545 GMT

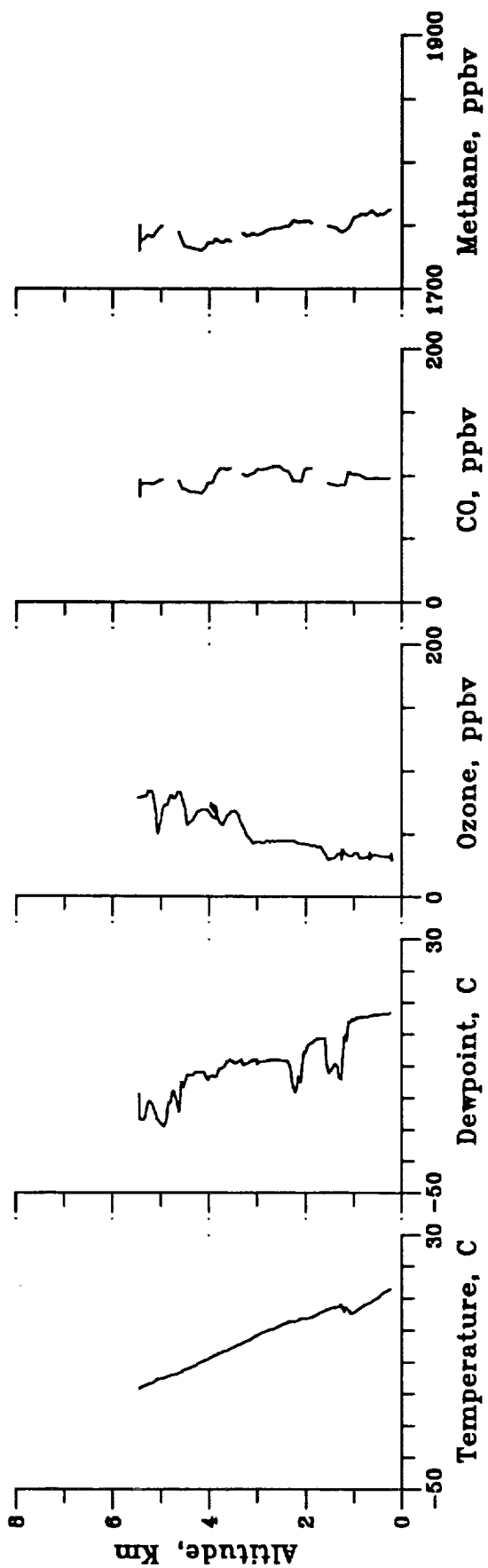


Figure B5.5

# ABLE-3B CANADIAN MISSION: FLIGHT 6.

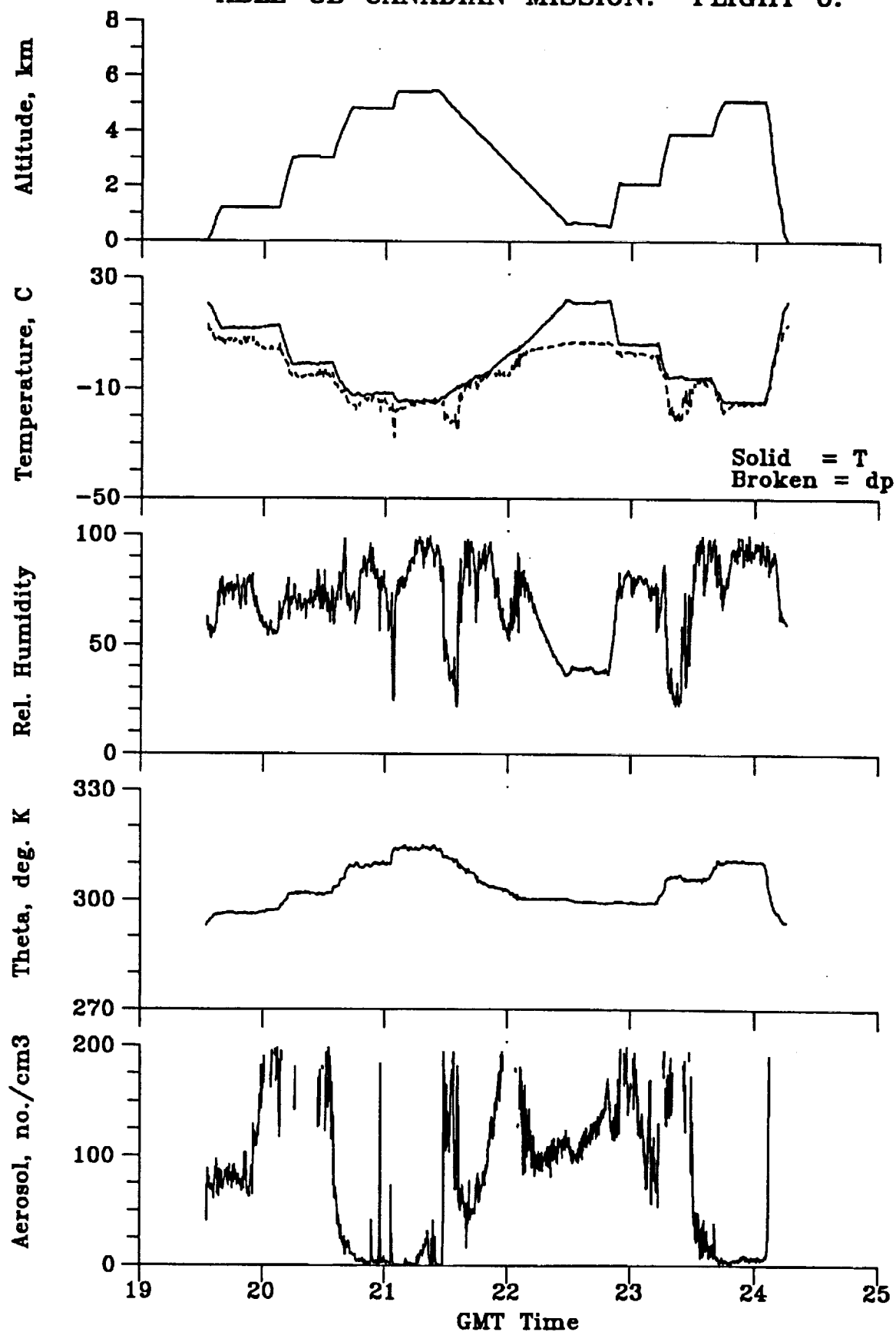


Figure B6.1

# ABLE-3B CANADIAN MISSION: FLIGHT 6.

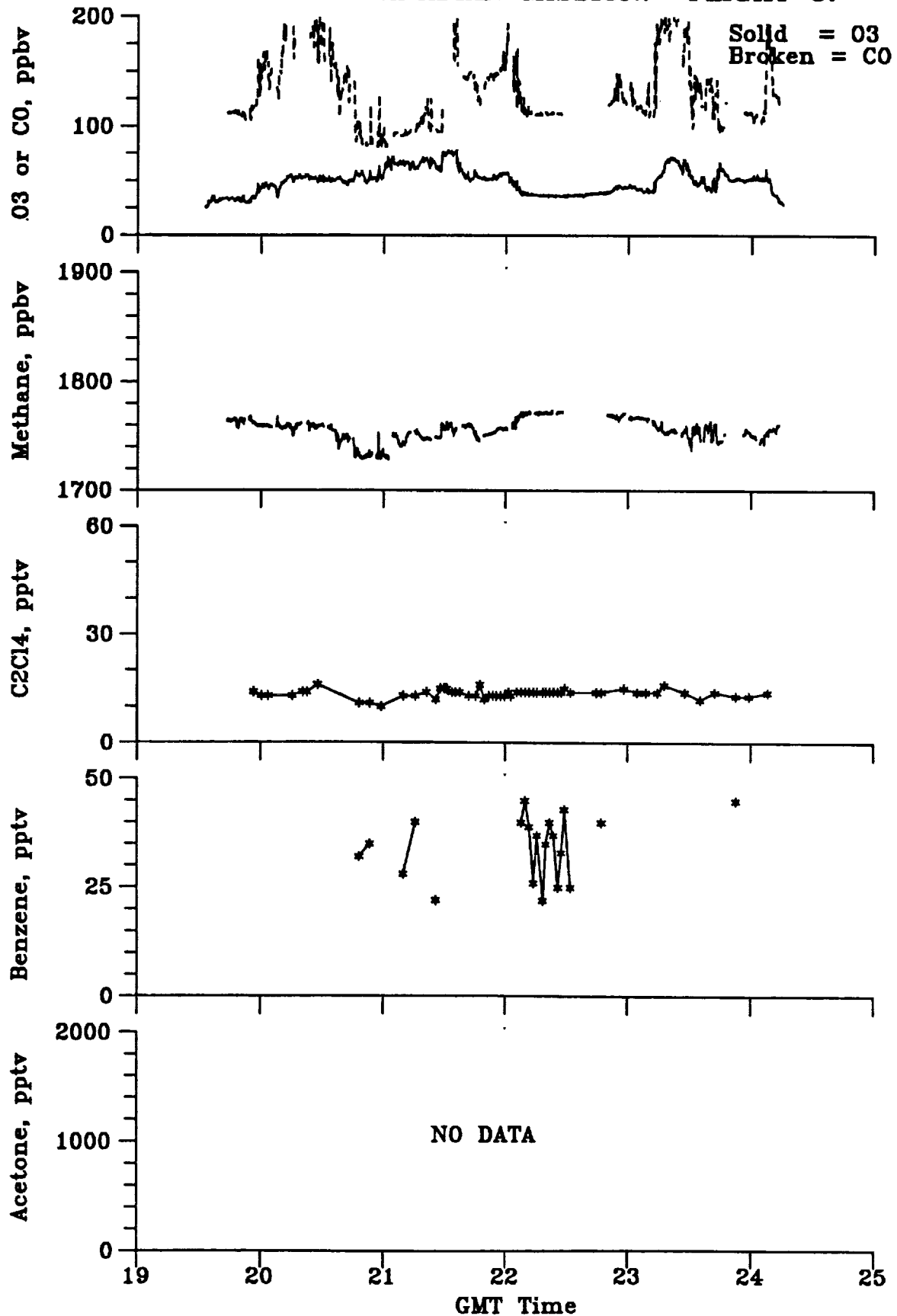


Figure B6.2

# ABLE-3B CANADIAN MISSION: FLIGHT 6.

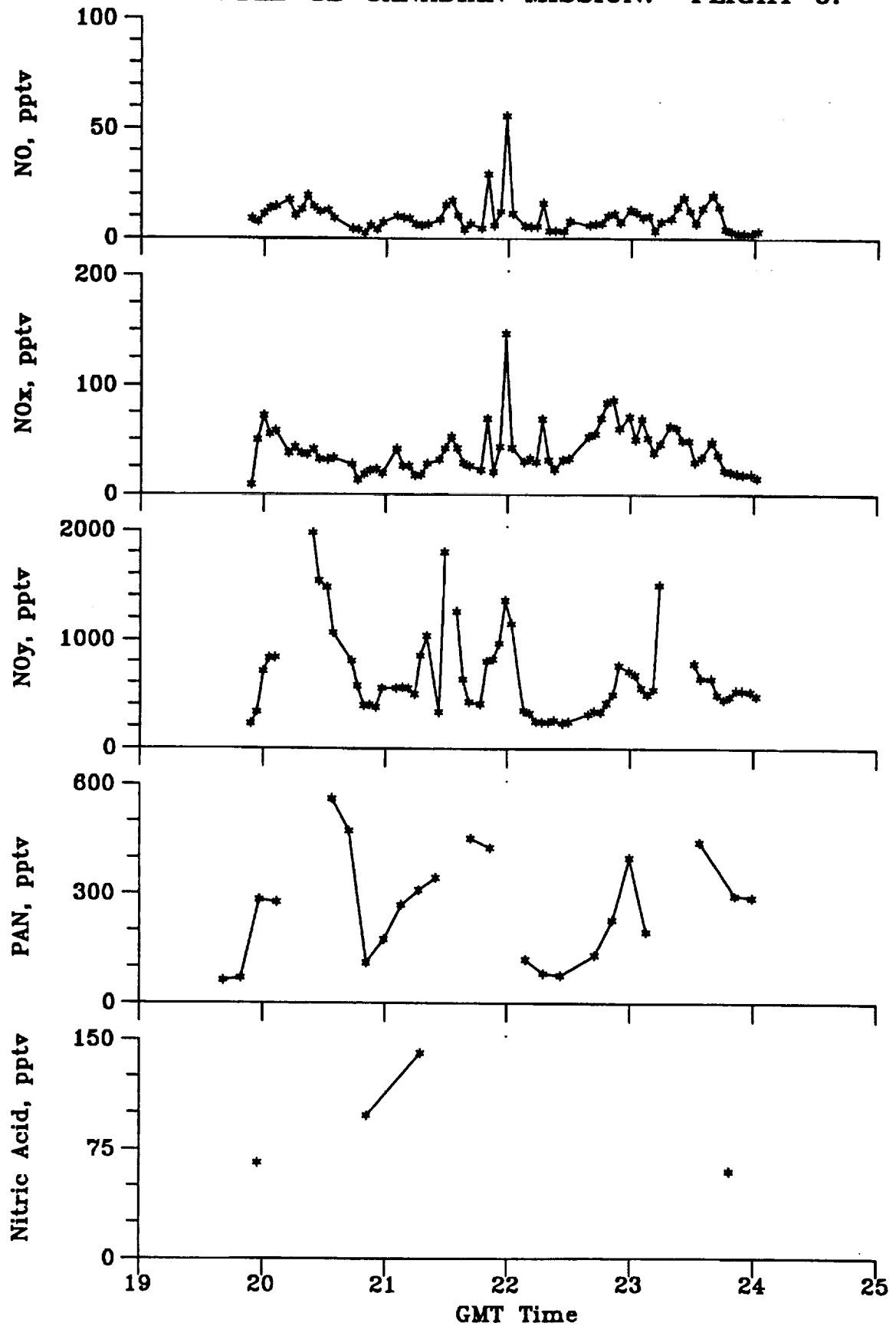


Figure B6.3

# ABLE-3B CANADIAN MISSION: FLIGHT 6.

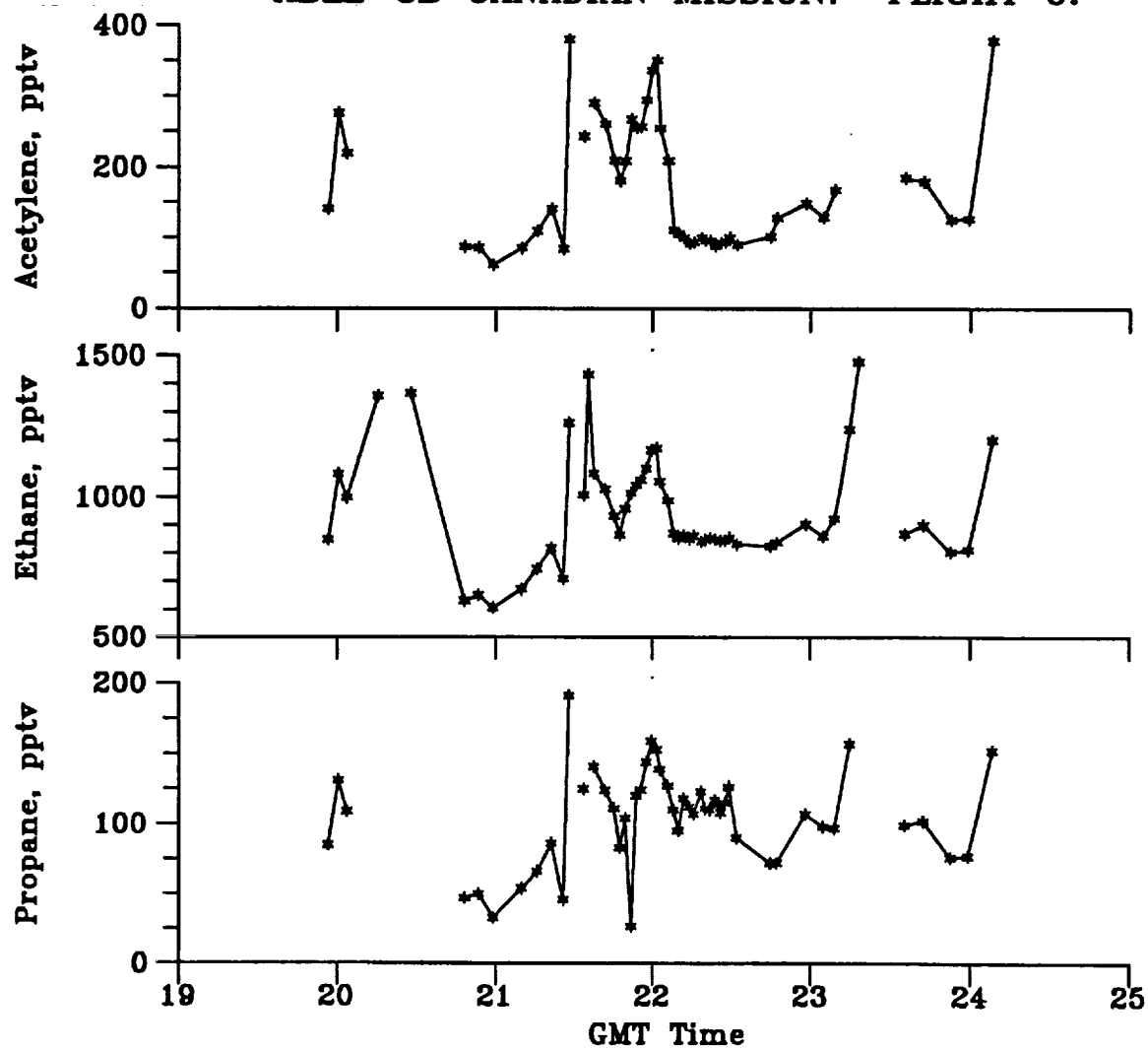
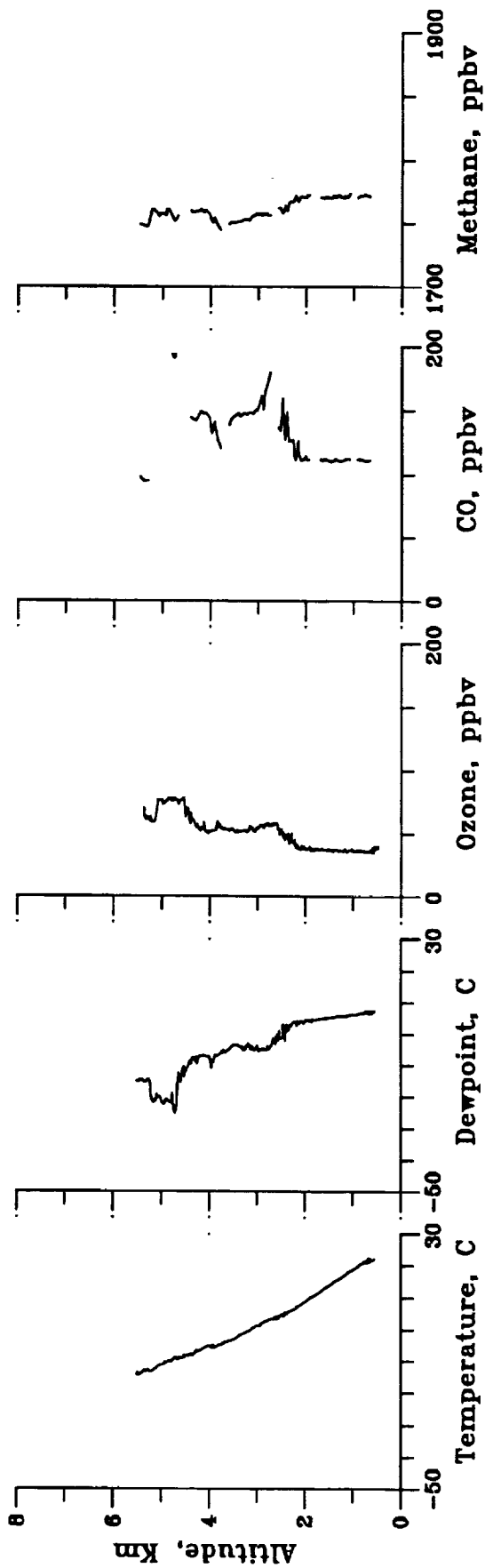


Figure B6.4

ABLE-3B CANADIAN MISSION: FLIGHT 6 PROFILE AT 2130 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 6 PROFILE AT 0010 GMT

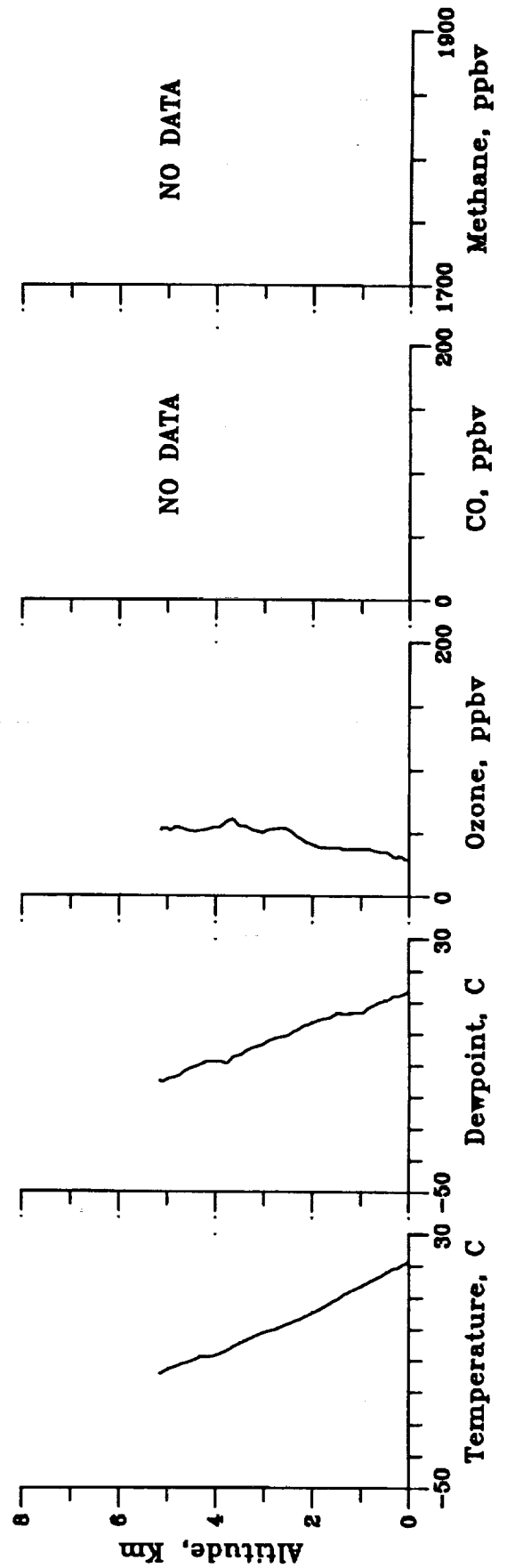


Figure B6.5

# ABLE-3B CANADIAN MISSION: FLIGHT 7.

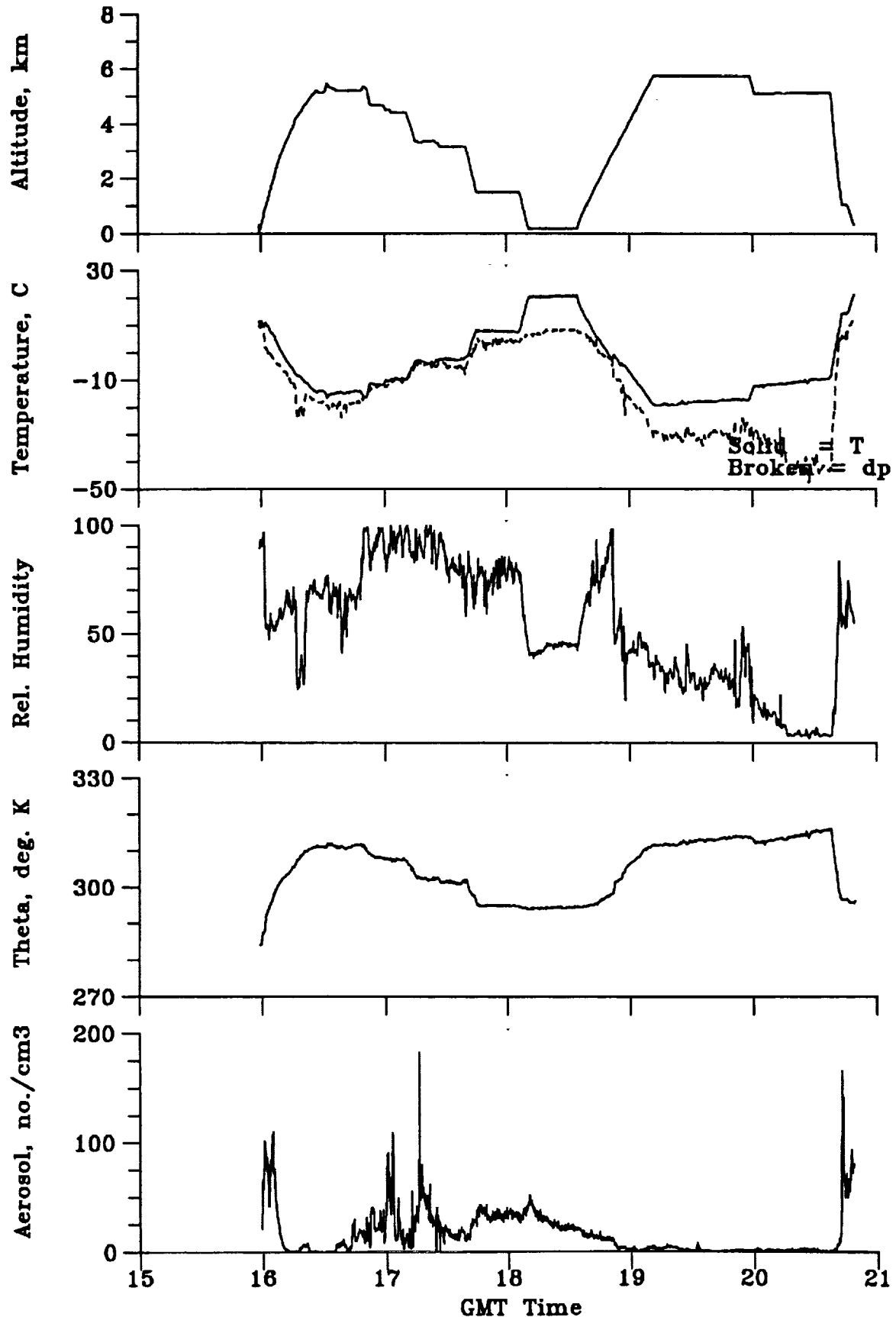


Figure B7.1



# ABLE-3B CANADIAN MISSION: FLIGHT 7.

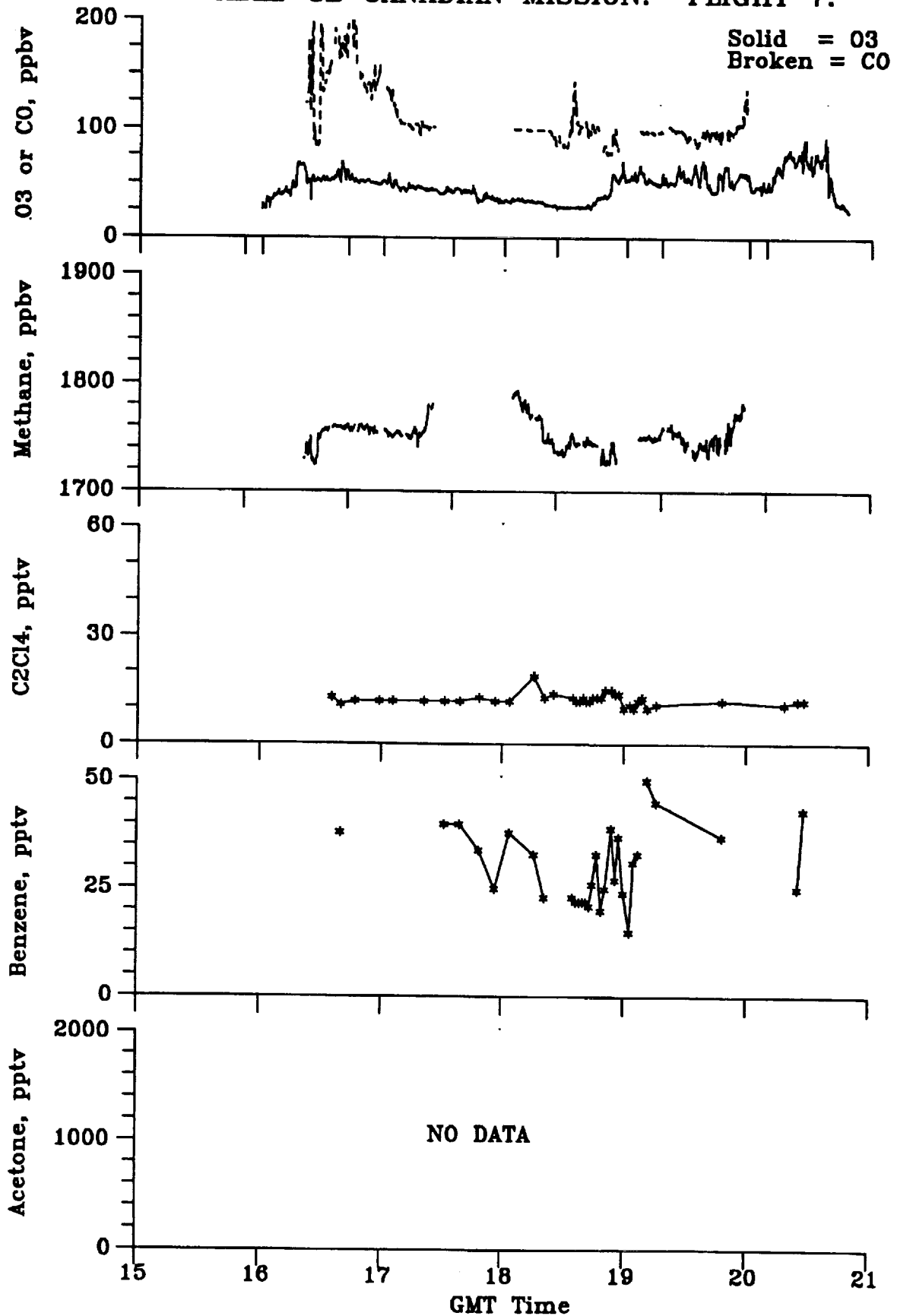


Figure B7.2

# ABLE-3B CANADIAN MISSION: FLIGHT 7.

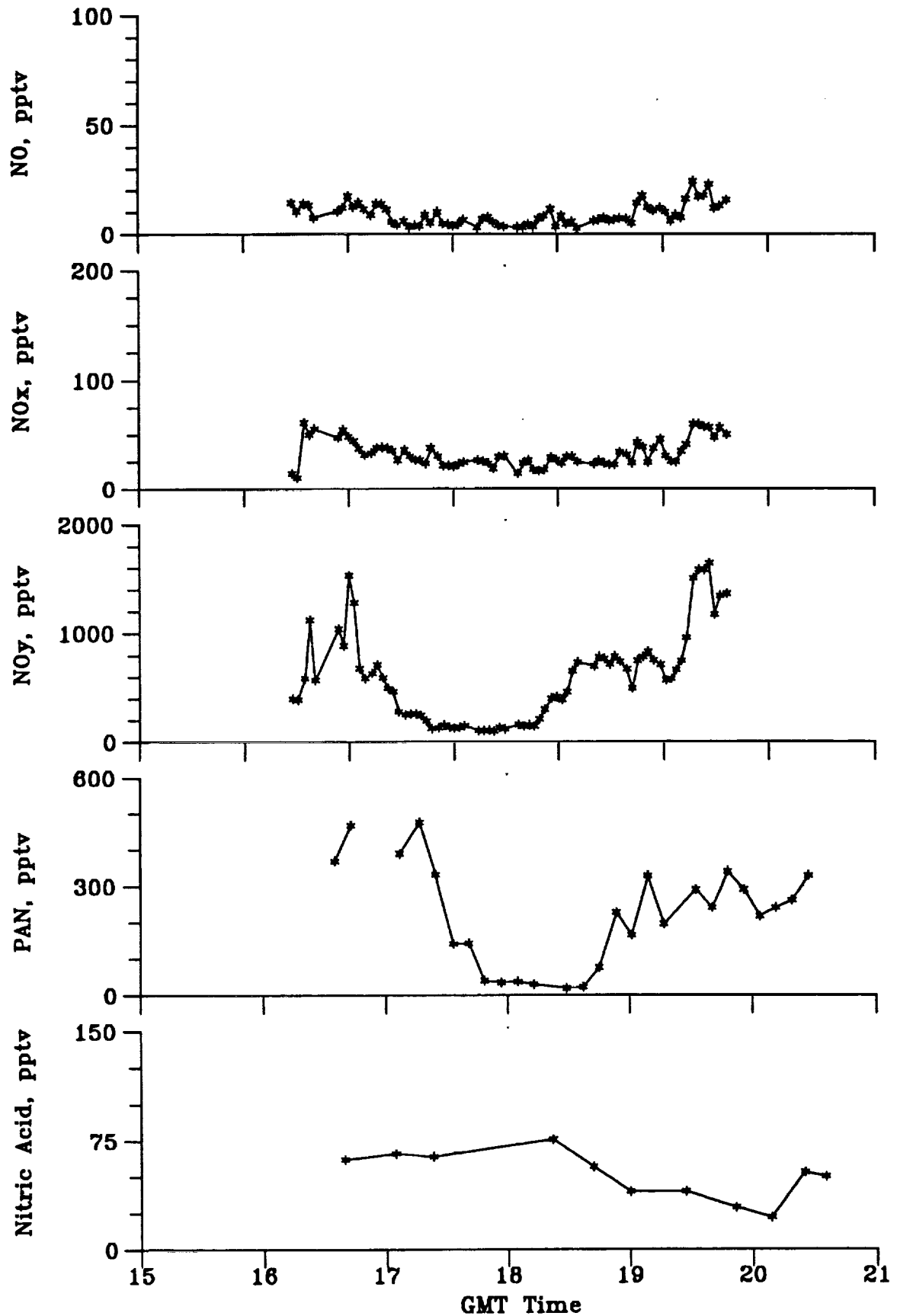


Figure B7.3

ABLE-3B CANADIAN MISSION: FLIGHT 7.

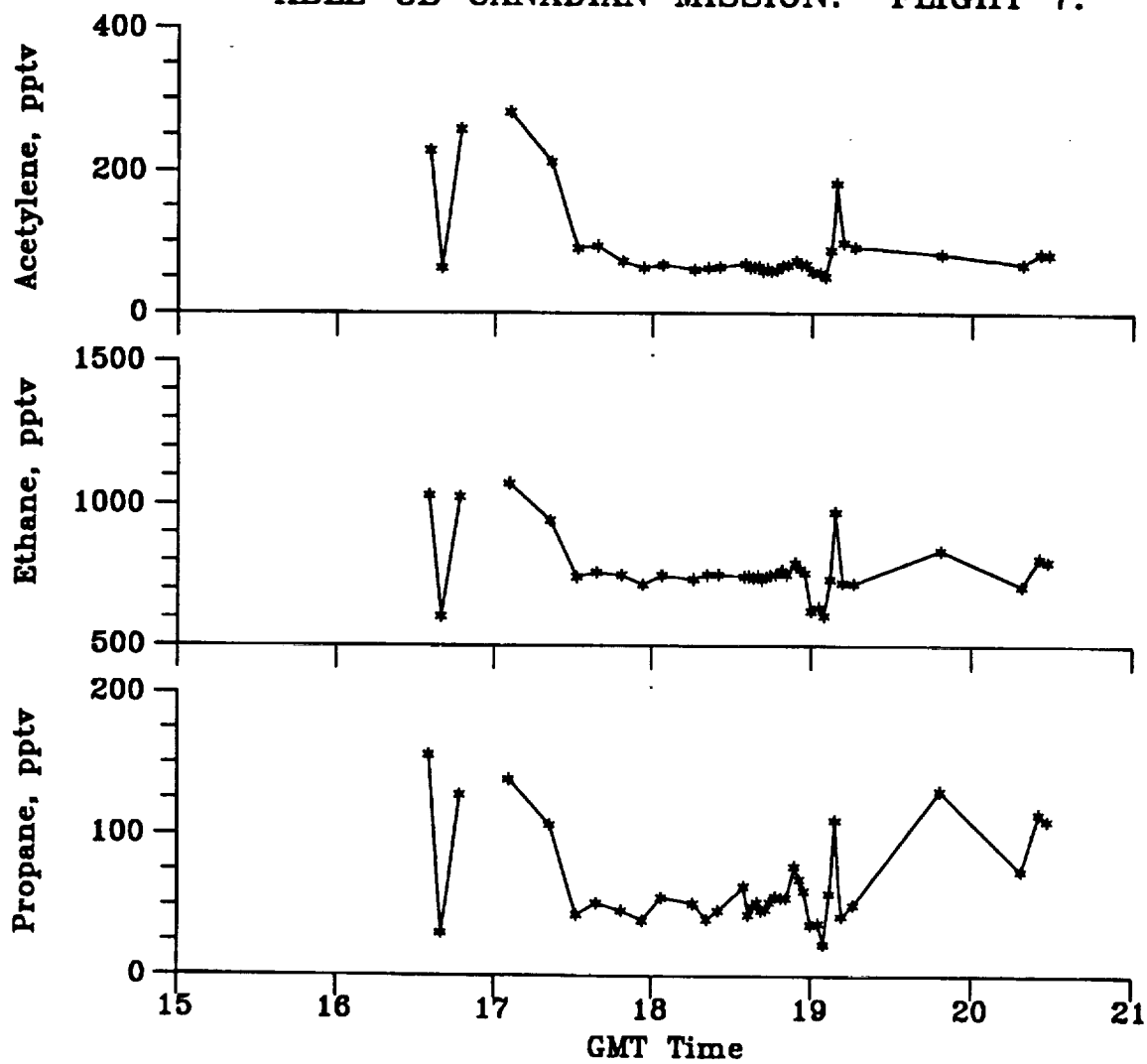
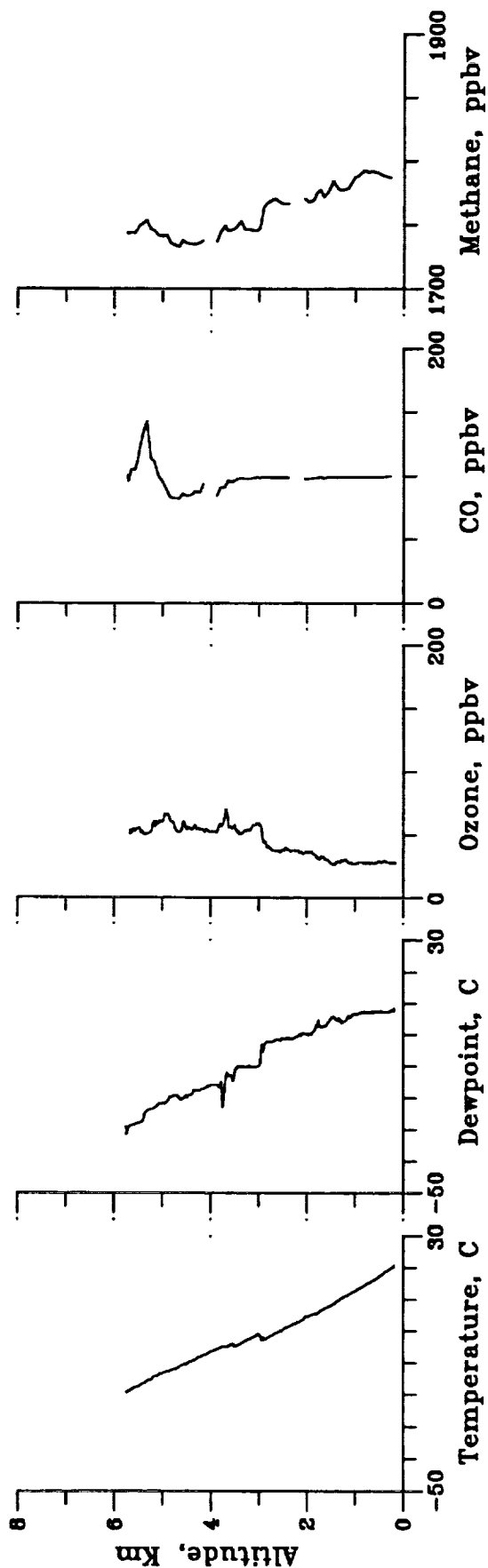


Figure B7.4

ABLE-3B CANADIAN MISSION: FLIGHT 7 PROFILE AT 1900 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 7 PROFILE AT 2045 GMT

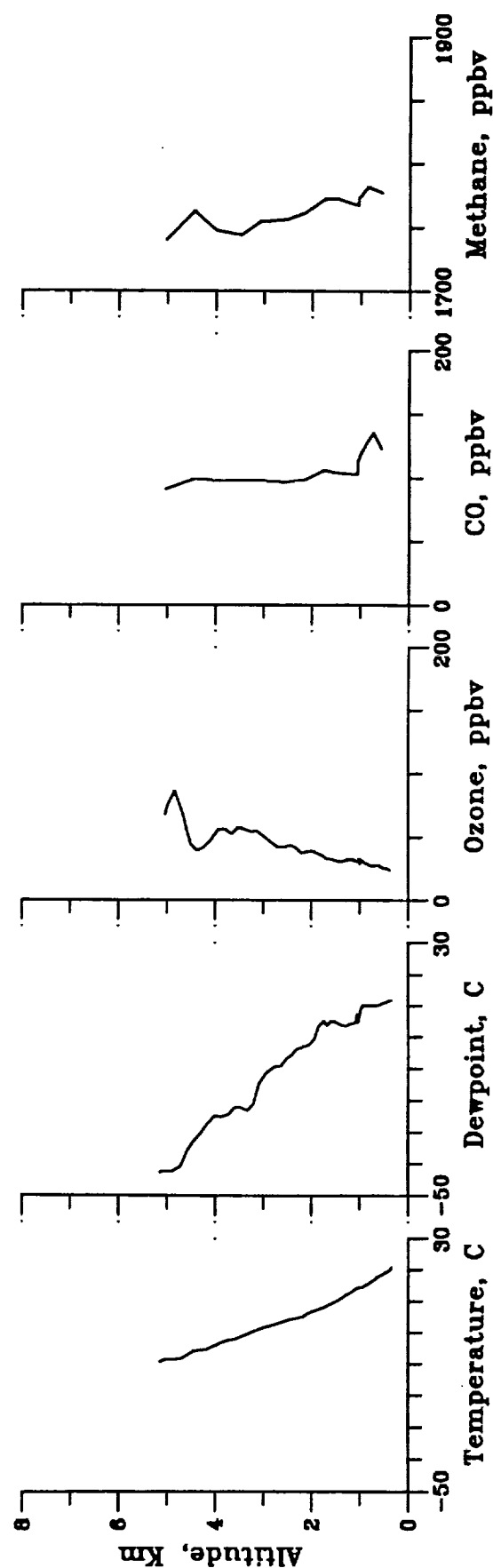


Figure B7.5

# ABLE-3B CANADIAN MISSION: FLIGHT 8.

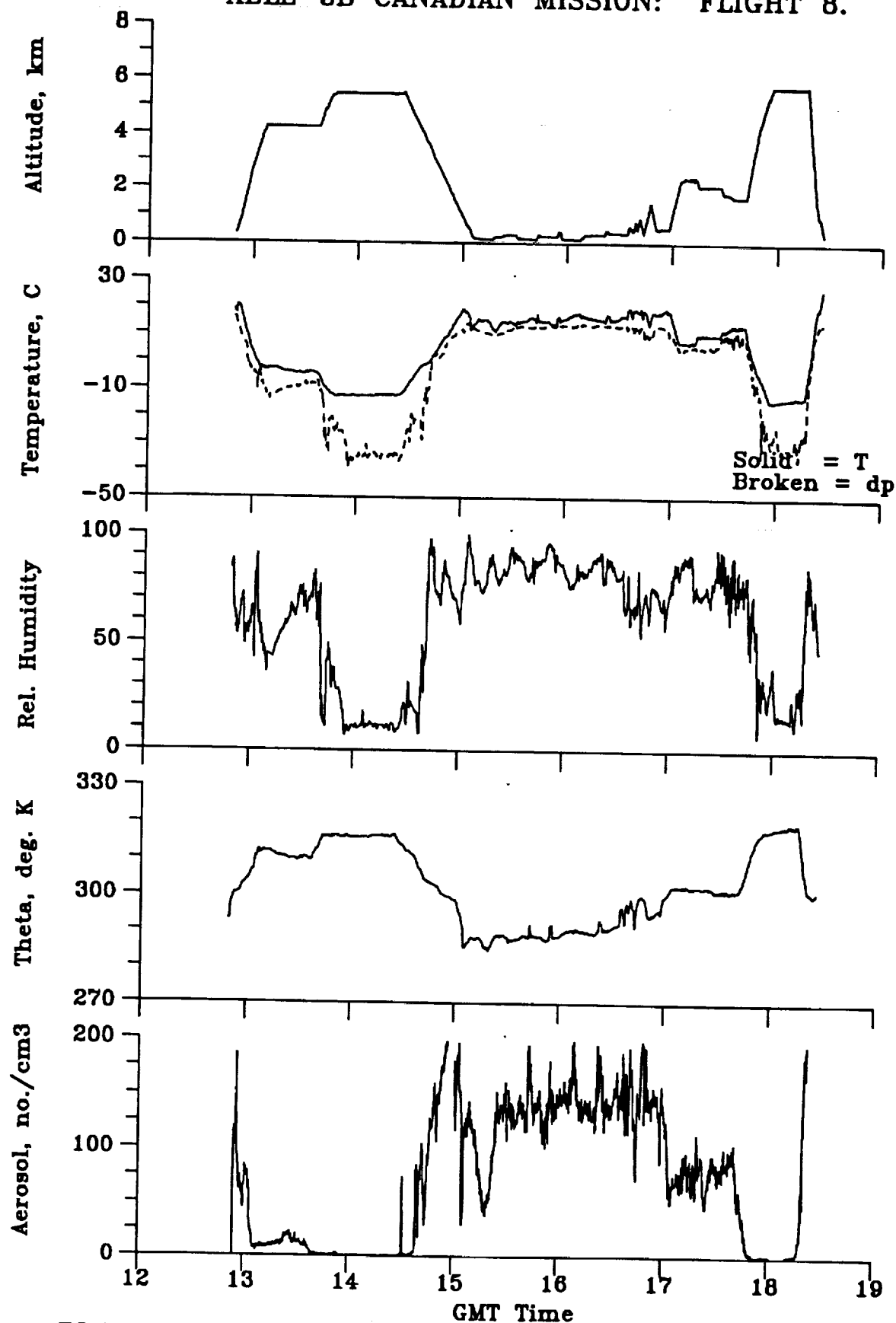


Figure B8.1

# ABLE-3B CANADIAN MISSION: FLIGHT 8.

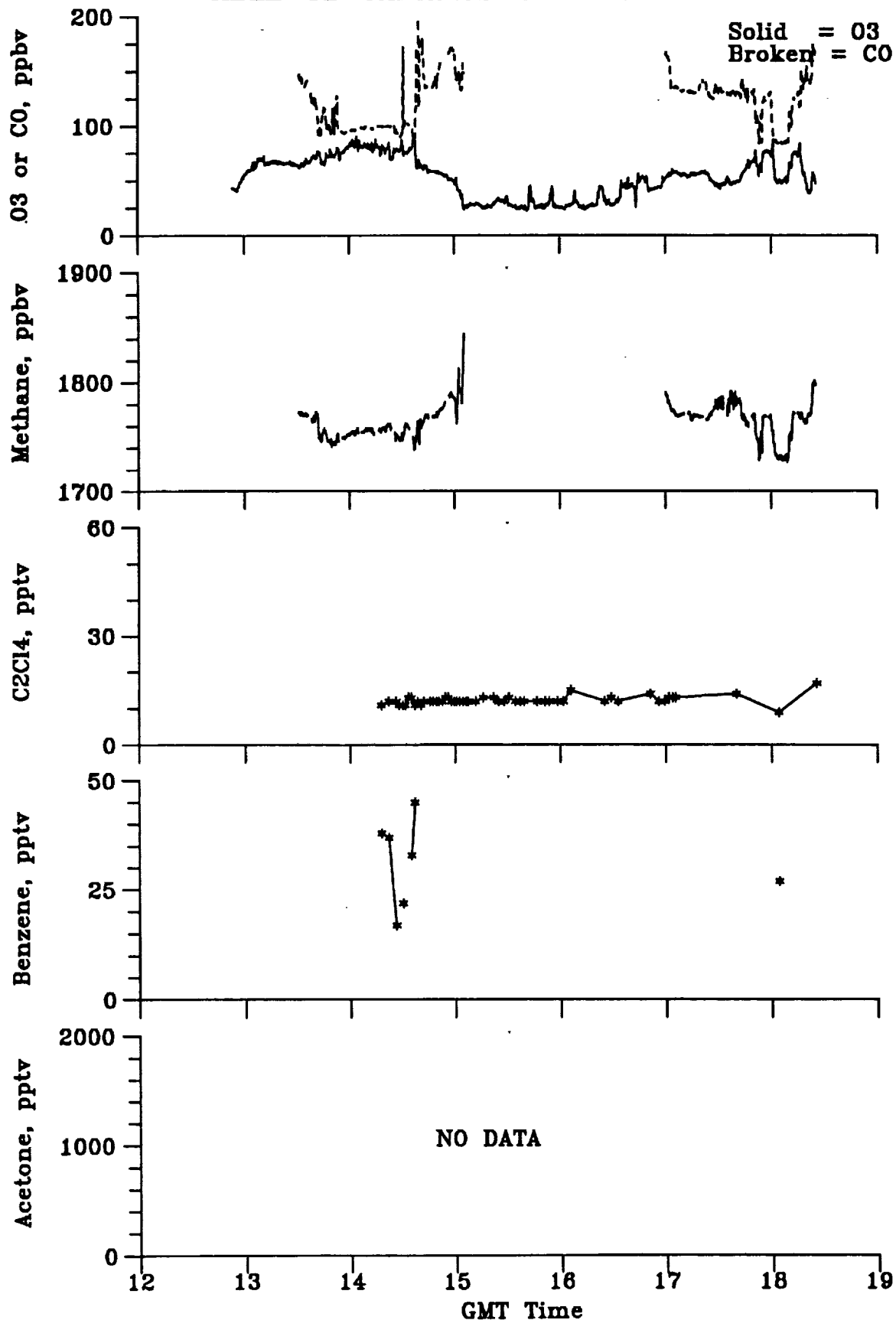


Figure B8.2

ABLE-3B CANADIAN MISSION: FLIGHT 8.

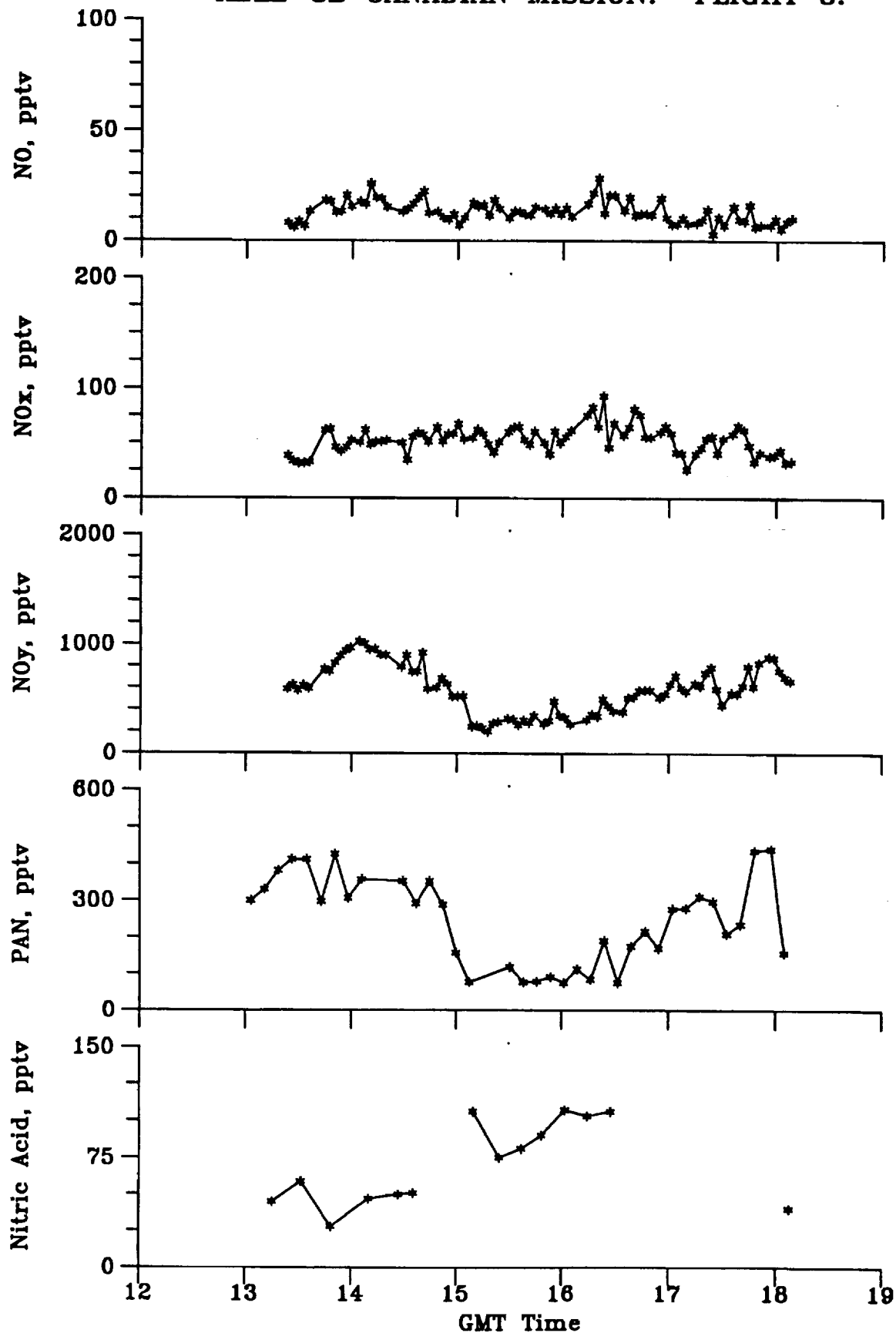


Figure B8.3

# ABLE-3B CANADIAN MISSION: FLIGHT 8.

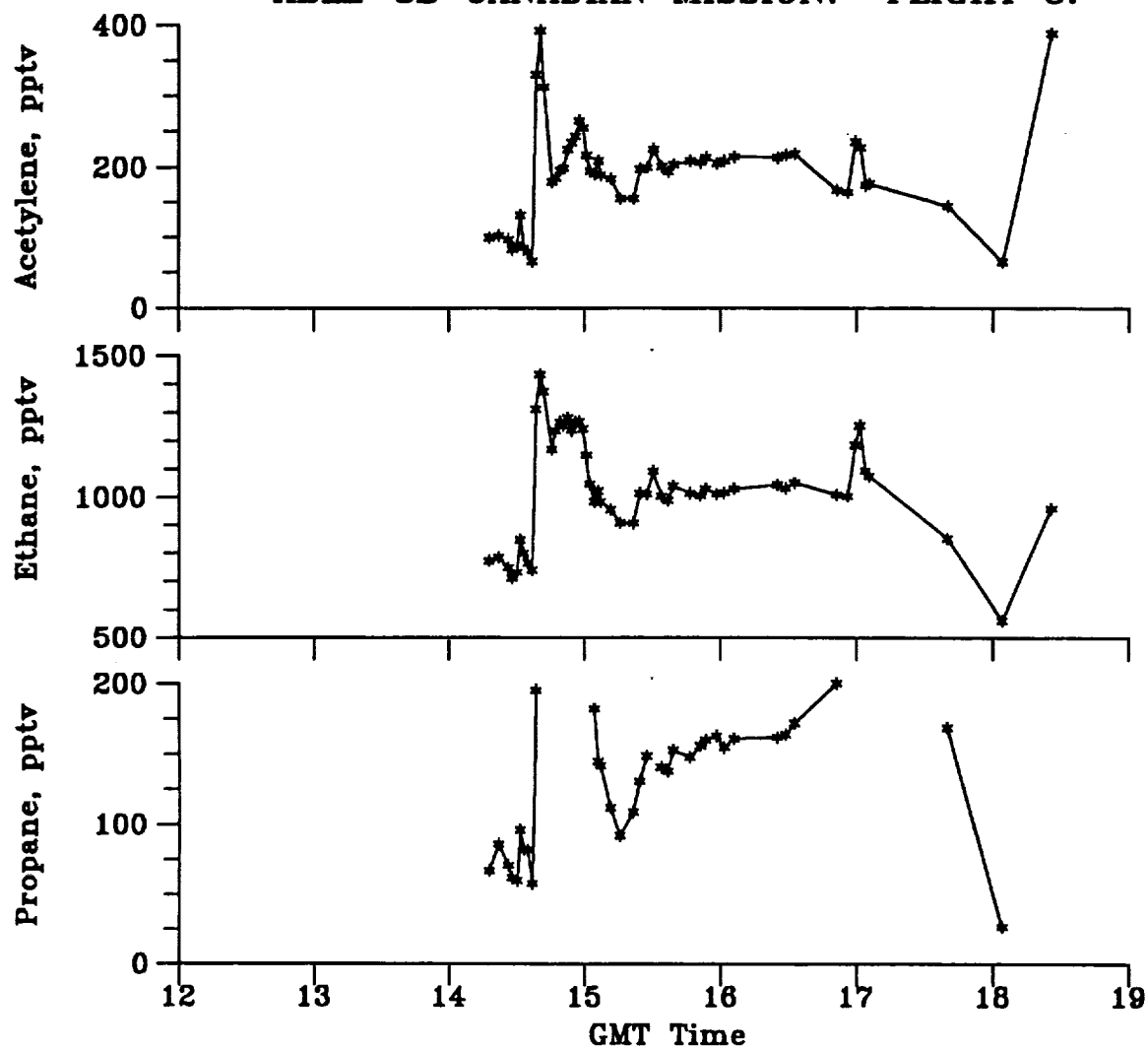
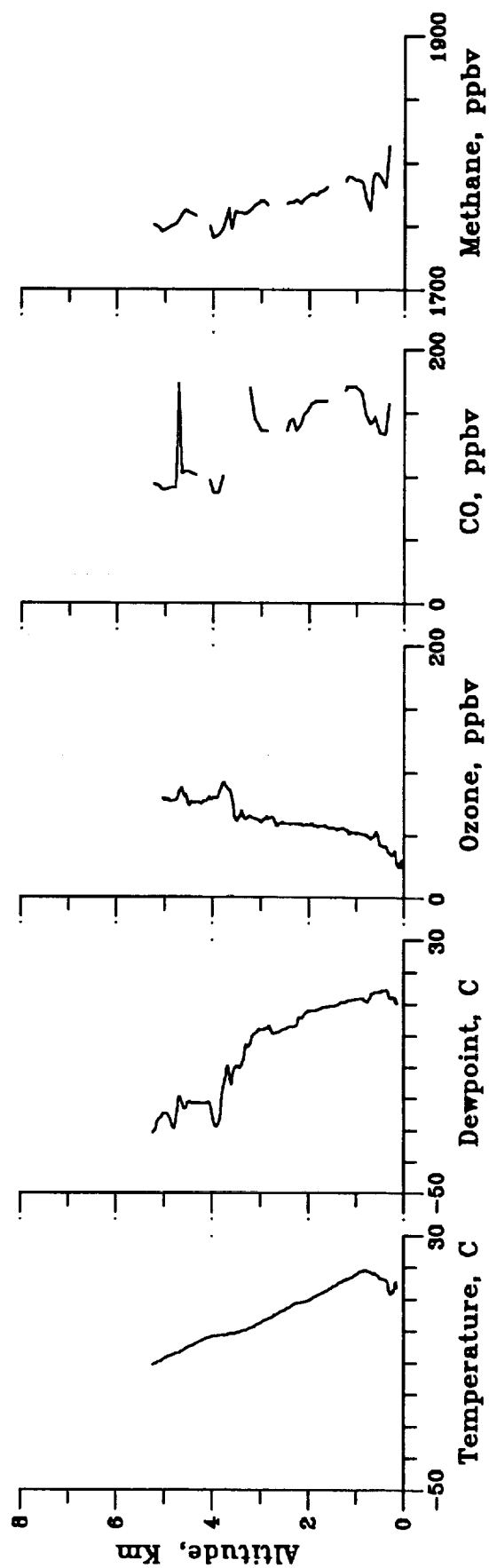


Figure B8.4



ABLE-3B CANADIAN MISSION: FLIGHT 8 PROFILE AT 1500 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 8 PROFILE AT 1820 GMT

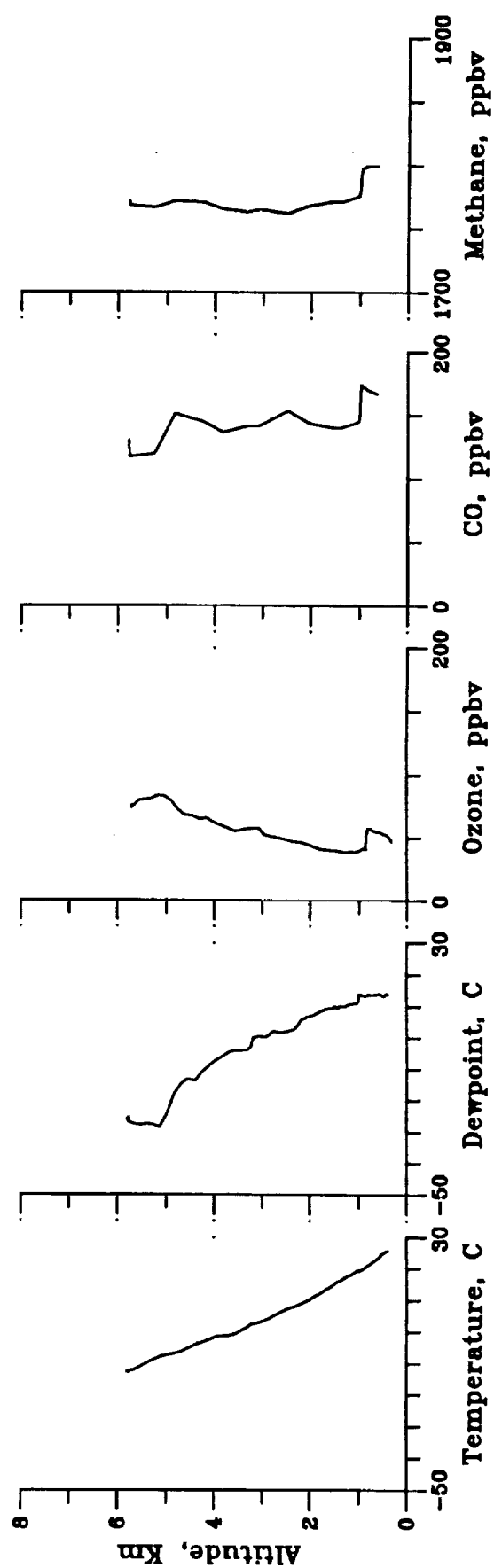


Figure B8.5

ABLE-3B CANADIAN MISSION: FLIGHT 9.

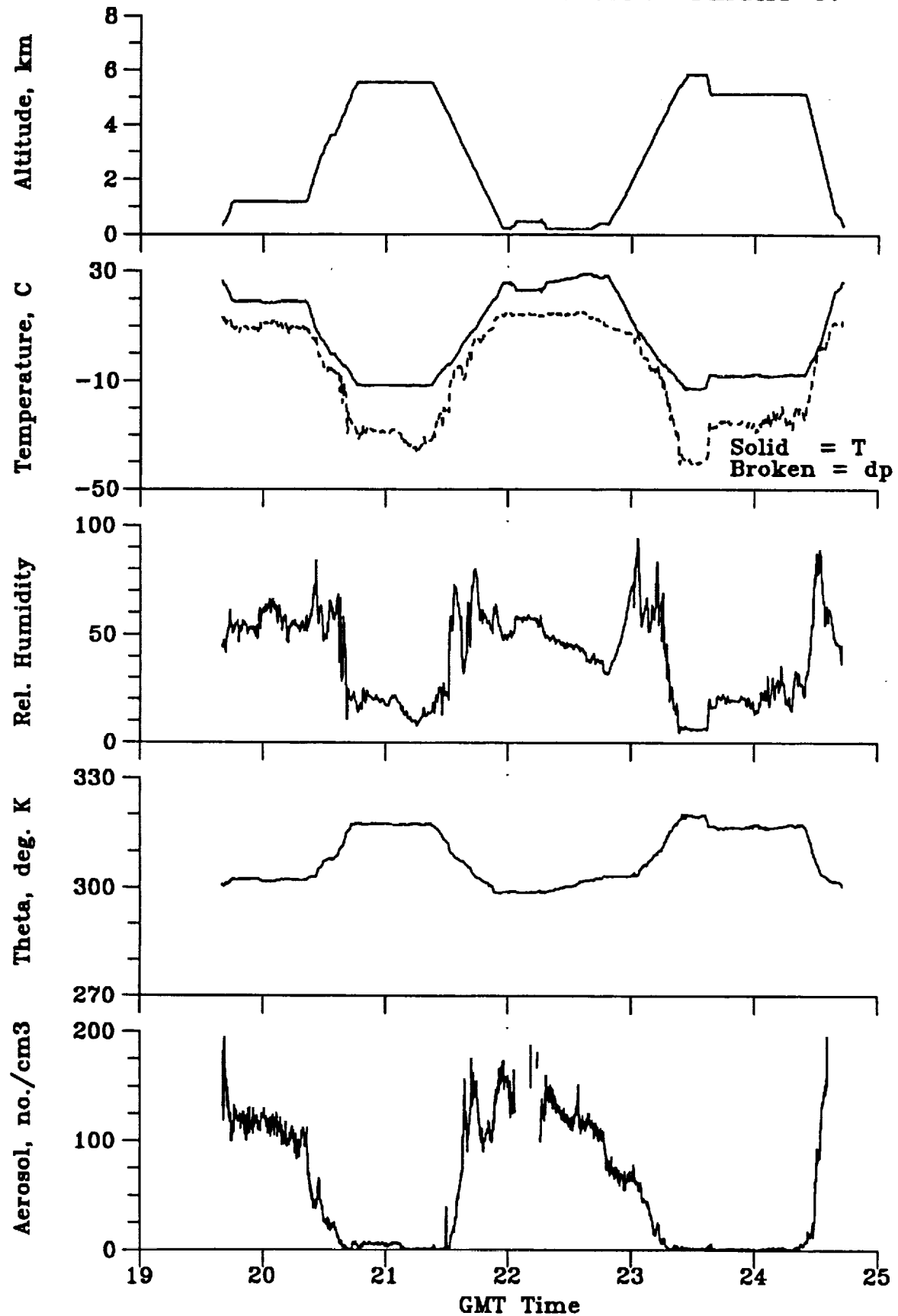


Figure B9.1

# ABLE-3B CANADIAN MISSION: FLIGHT 9.

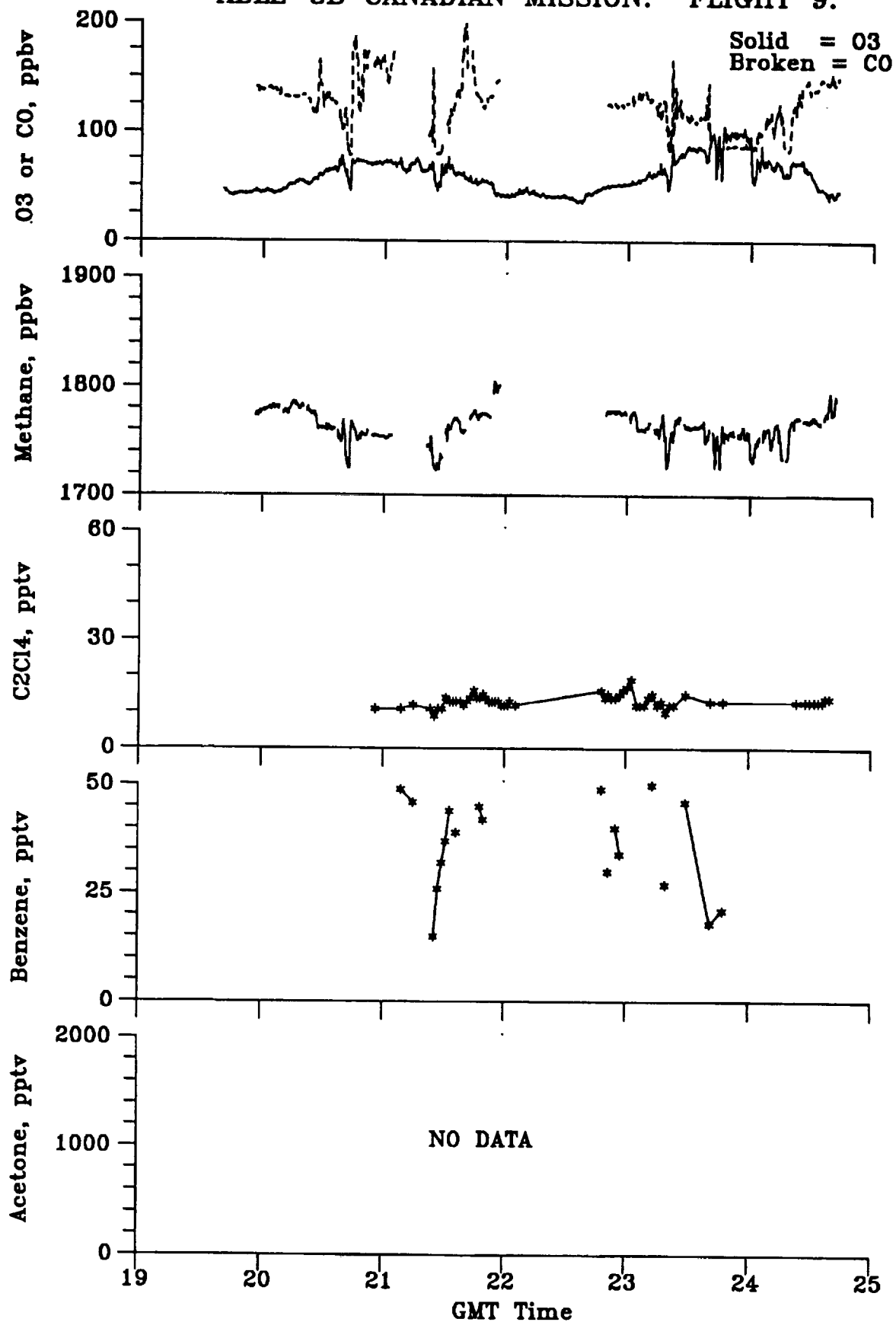


Figure B9.2

# ABLE-3B CANADIAN MISSION: FLIGHT 9.

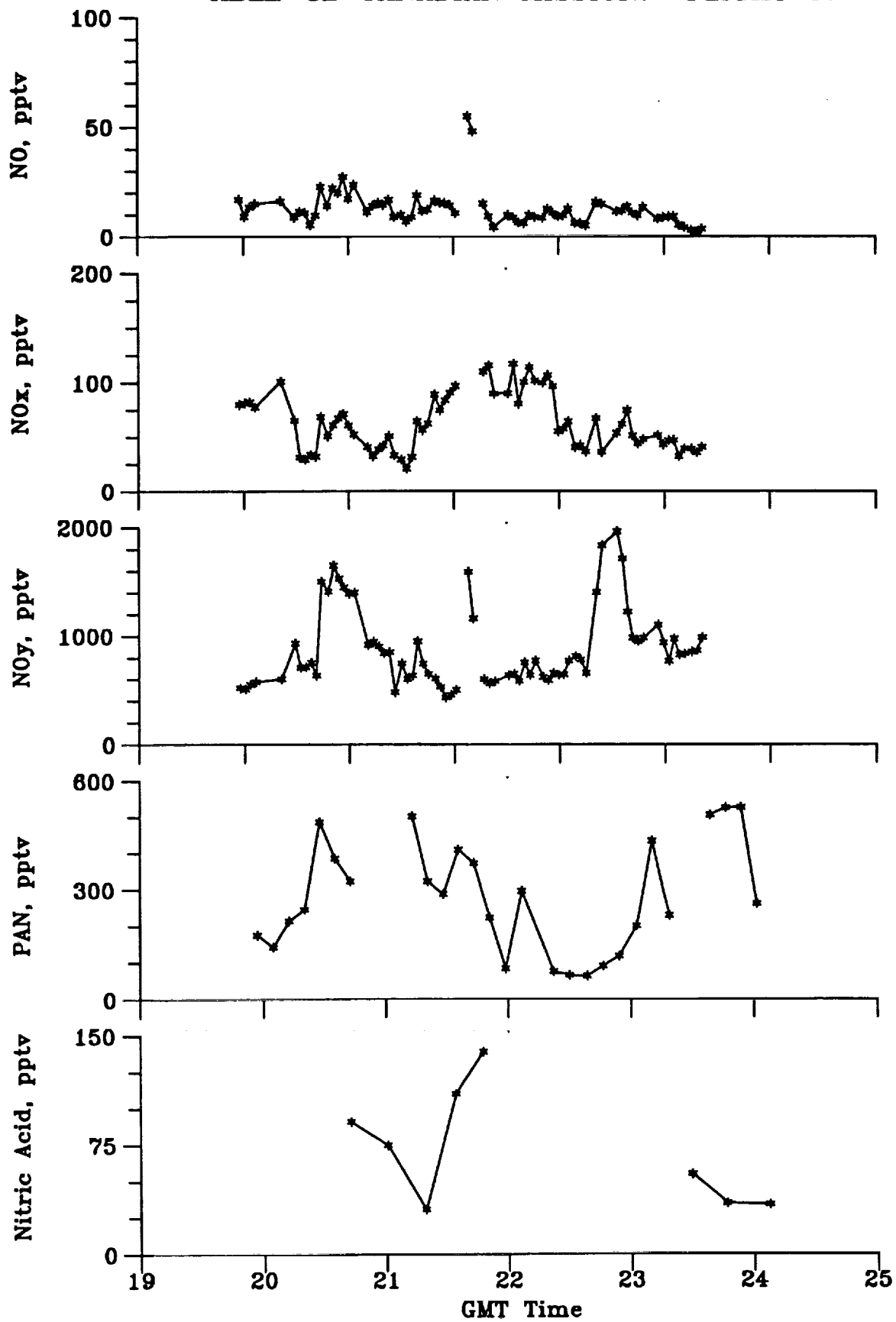


Figure B9.3

ABLE-3B CANADIAN MISSION: FLIGHT 9.

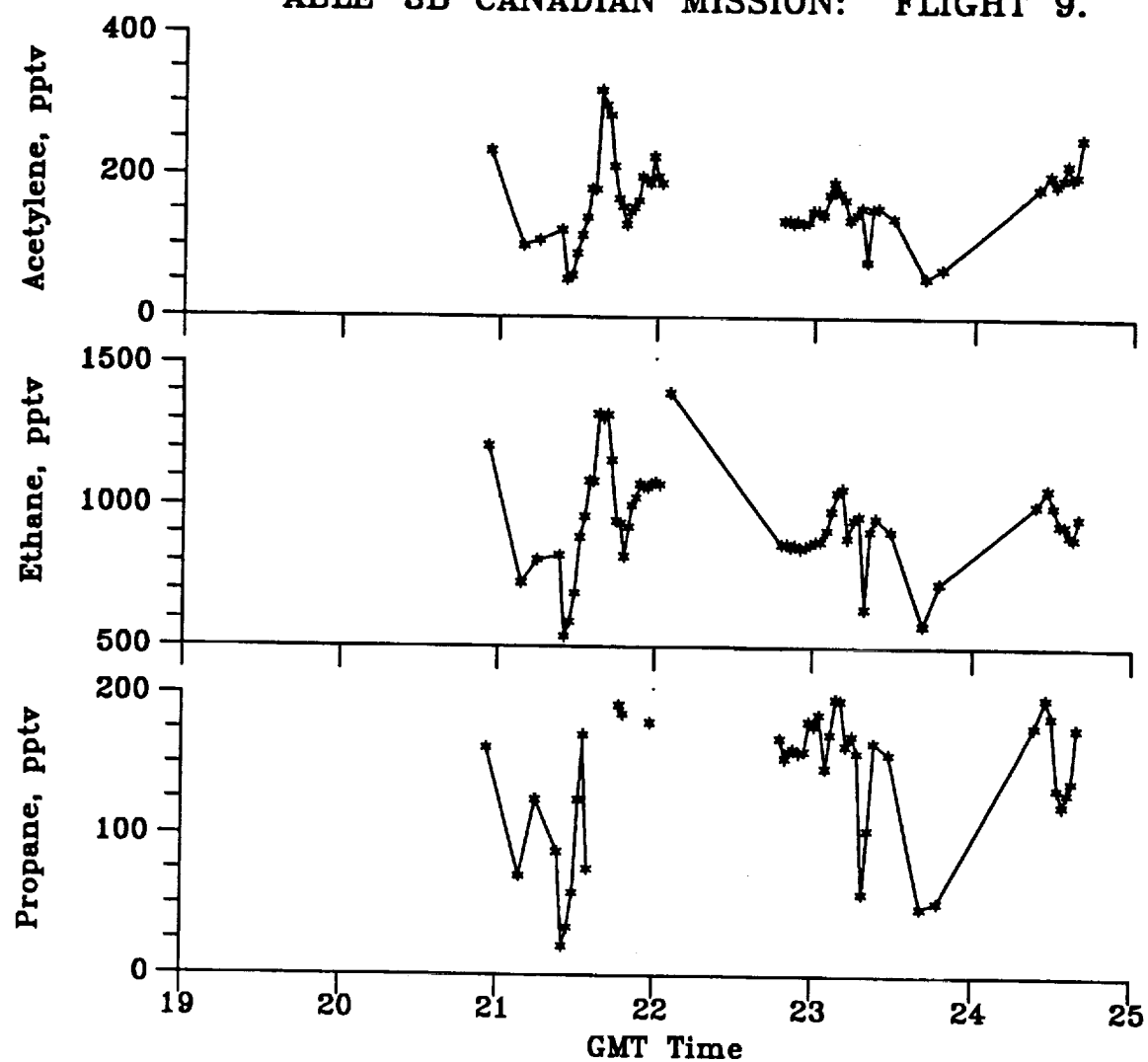
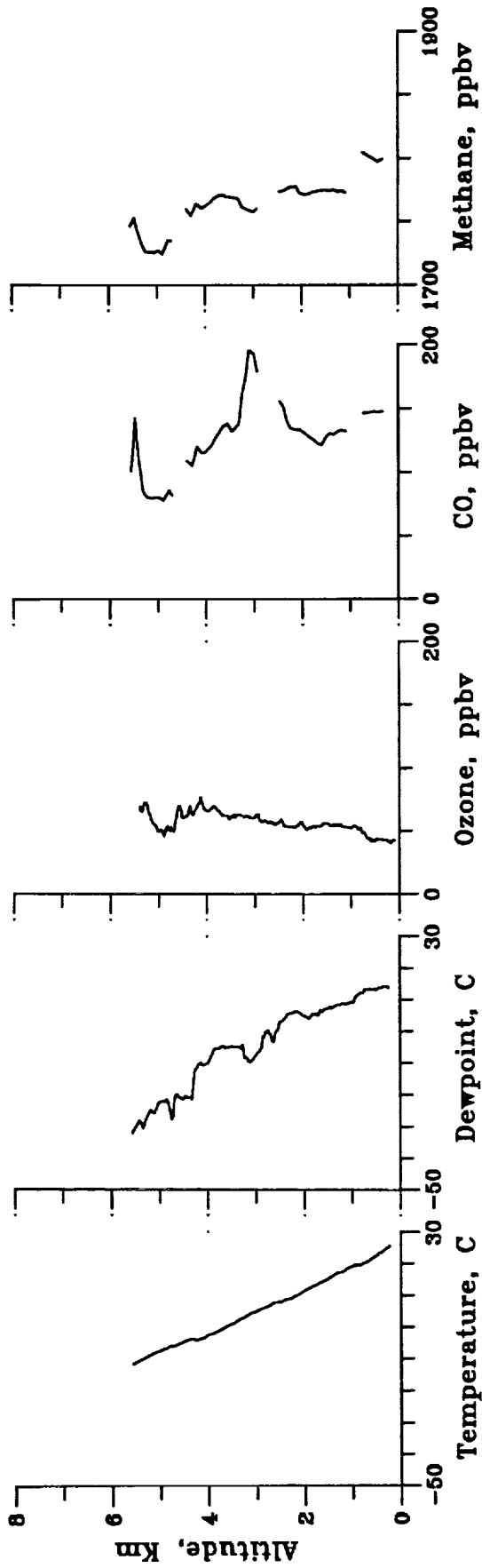


Figure B9.4

ABLE-3B CANADIAN MISSION: FLIGHT 9 PROFILE AT 2130 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 9 PROFILE AT 0030 GMT

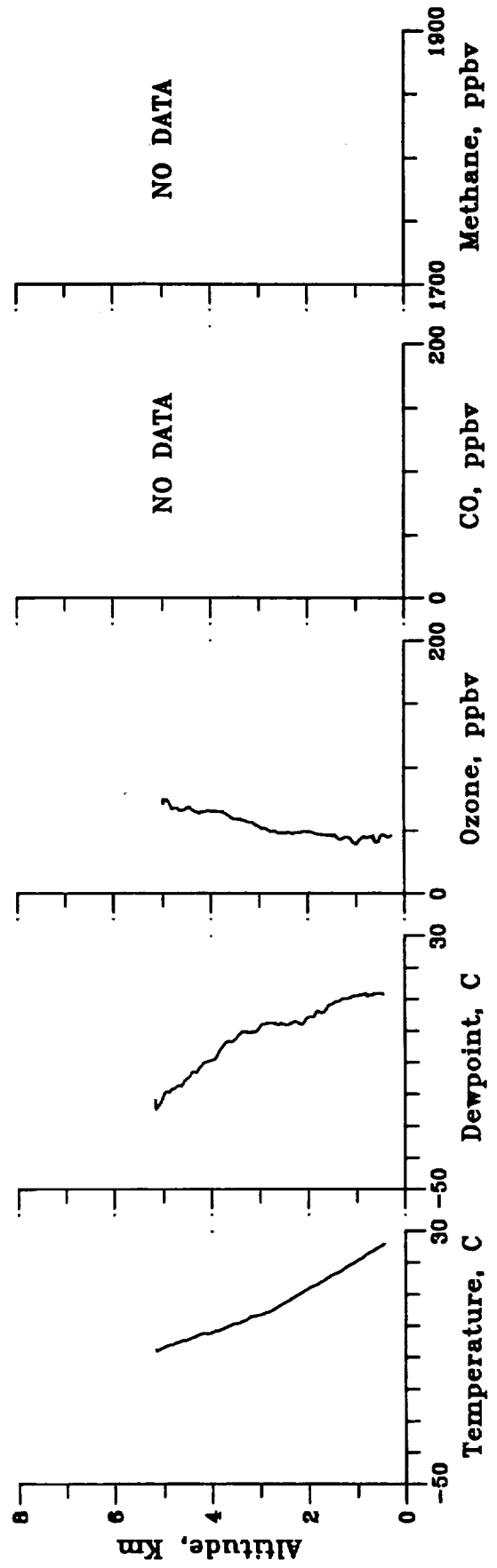


Figure B9.5

ABLE-3B CANADIAN MISSION: FLIGHT 10.

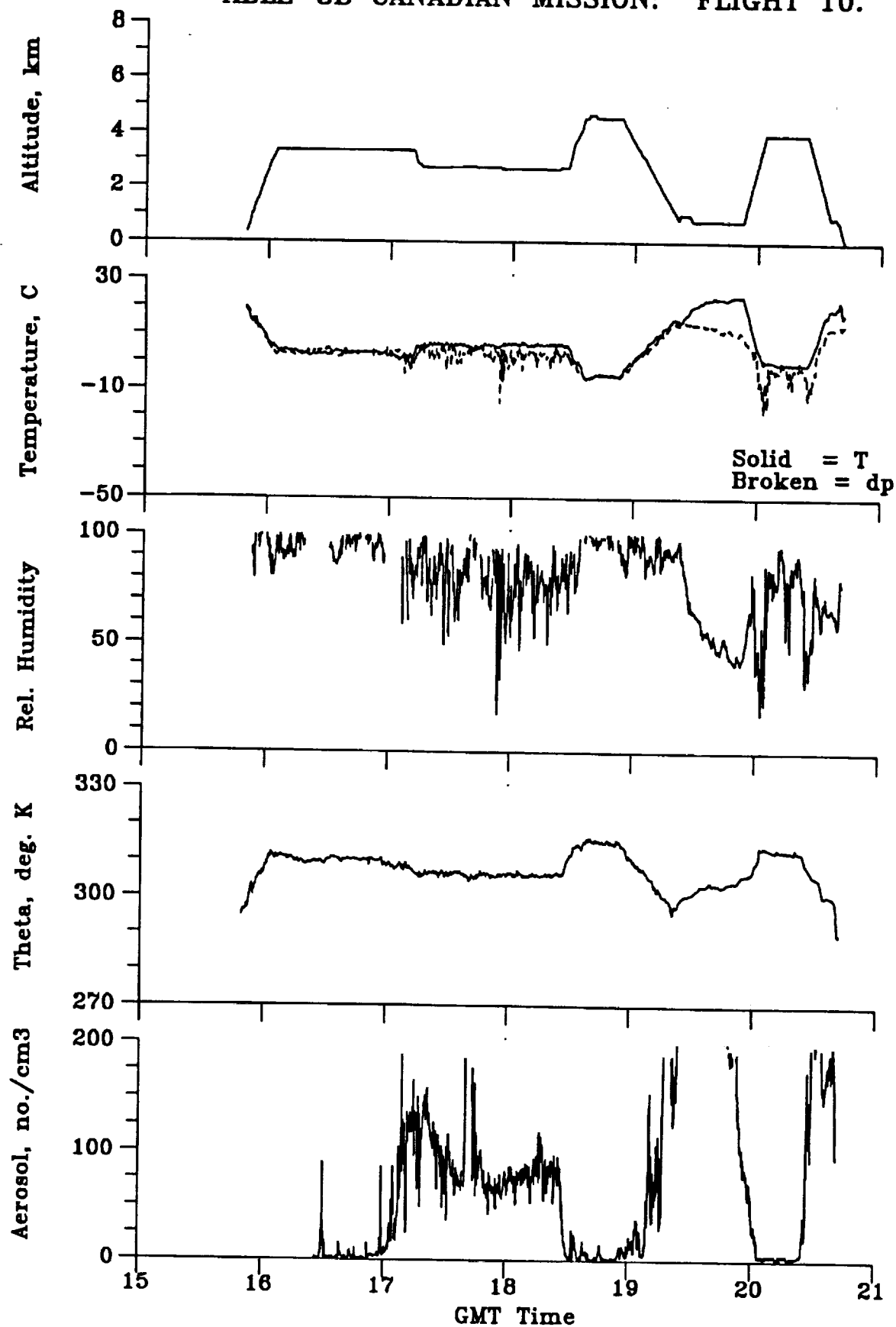


Figure B10.1

# ABLE-3B CANADIAN MISSION: FLIGHT 10.

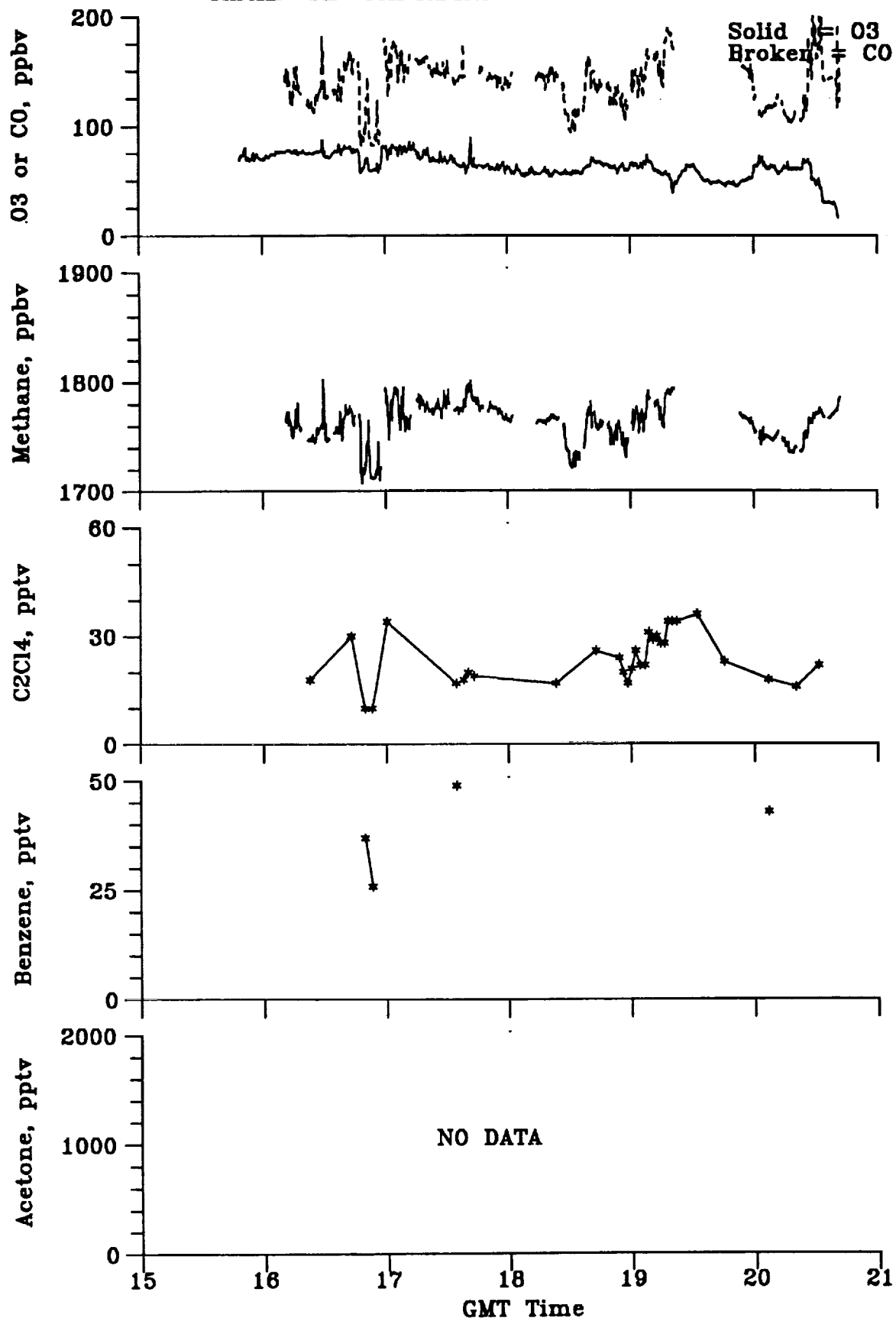


Figure B10.2



# ABLE-3B CANADIAN MISSION: FLIGHT 10.

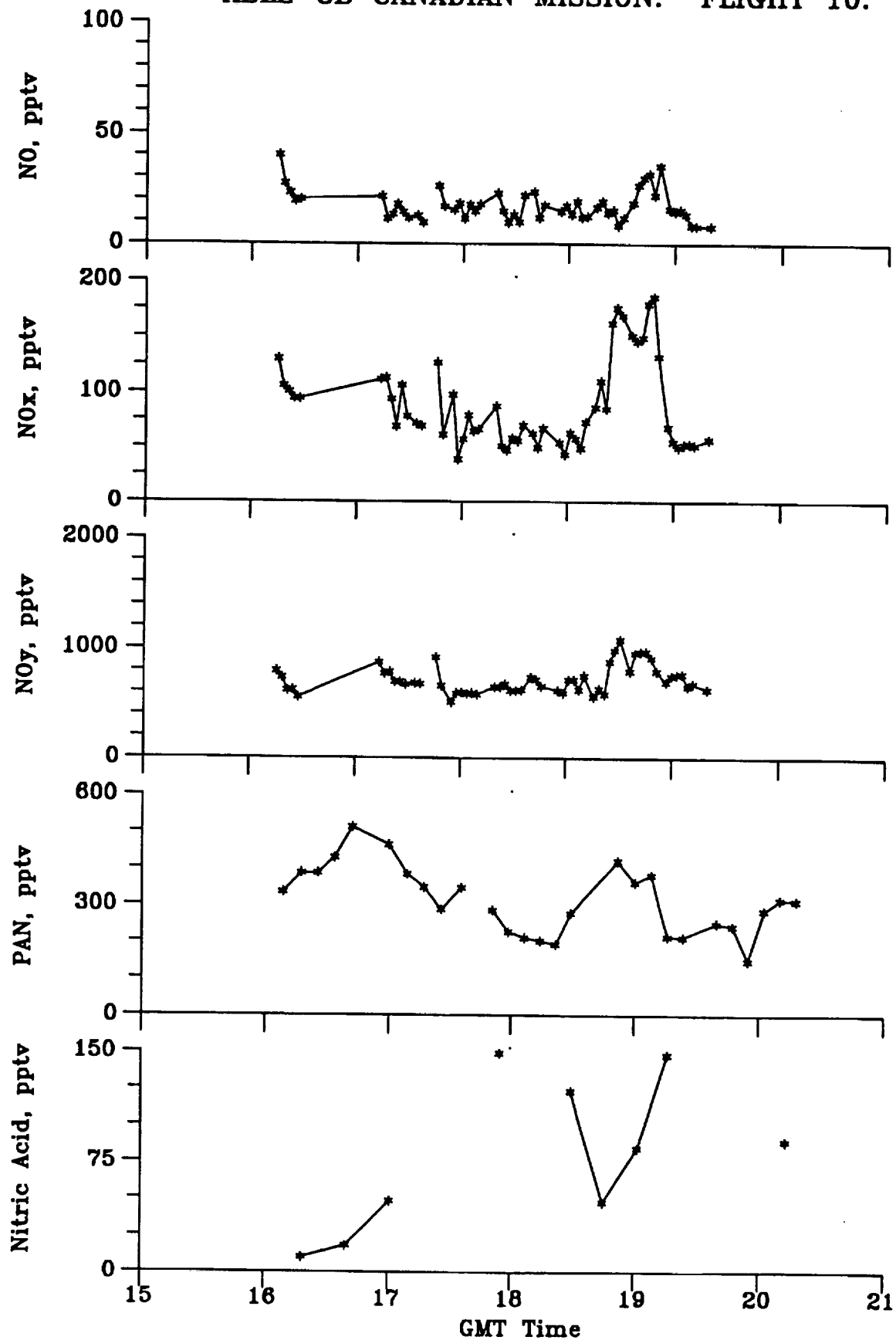


Figure B10.3

# ABLE-3B CANADIAN MISSION: FLIGHT 10.

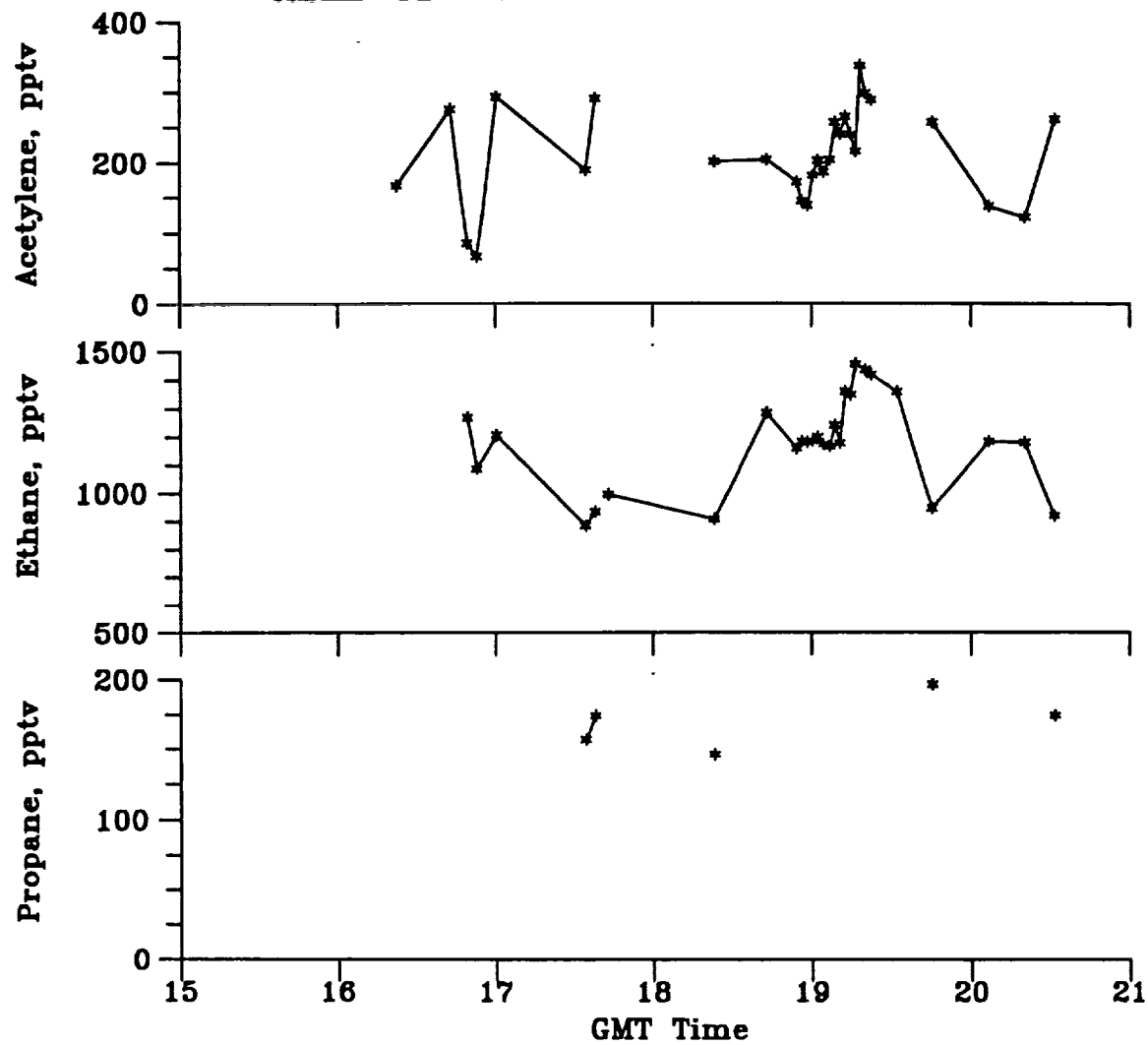
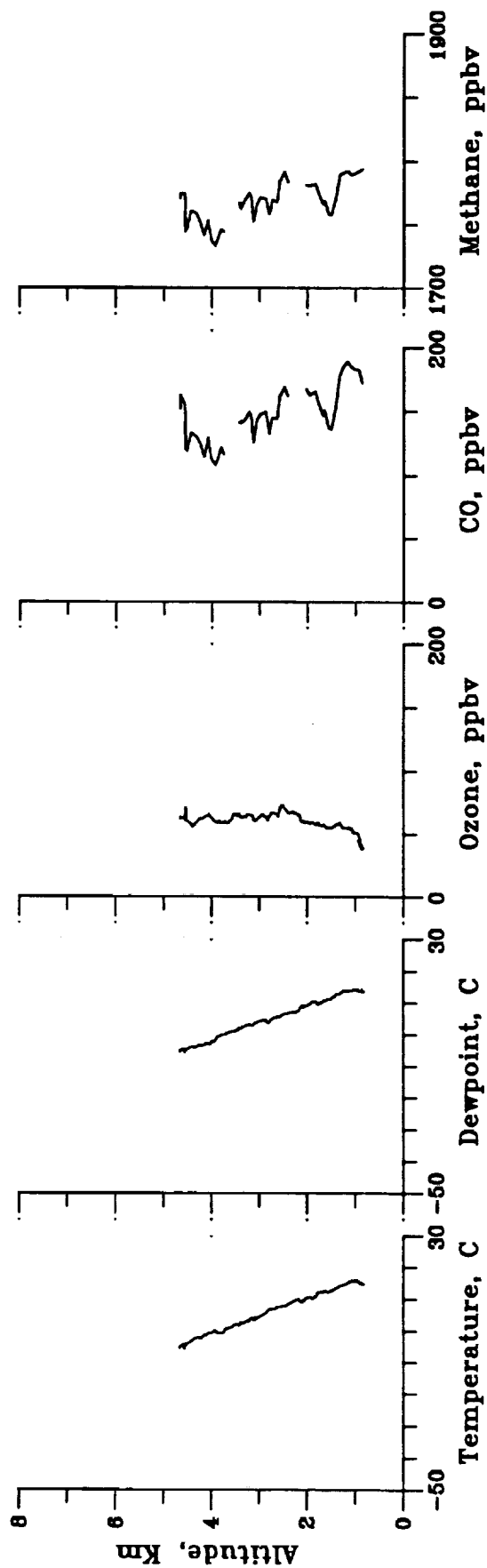


Figure B10.4

ABLE-3B CANADIAN MISSION: FLIGHT 10 PROFILE AT 1900 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 10 PROFILE AT 2030 GMT

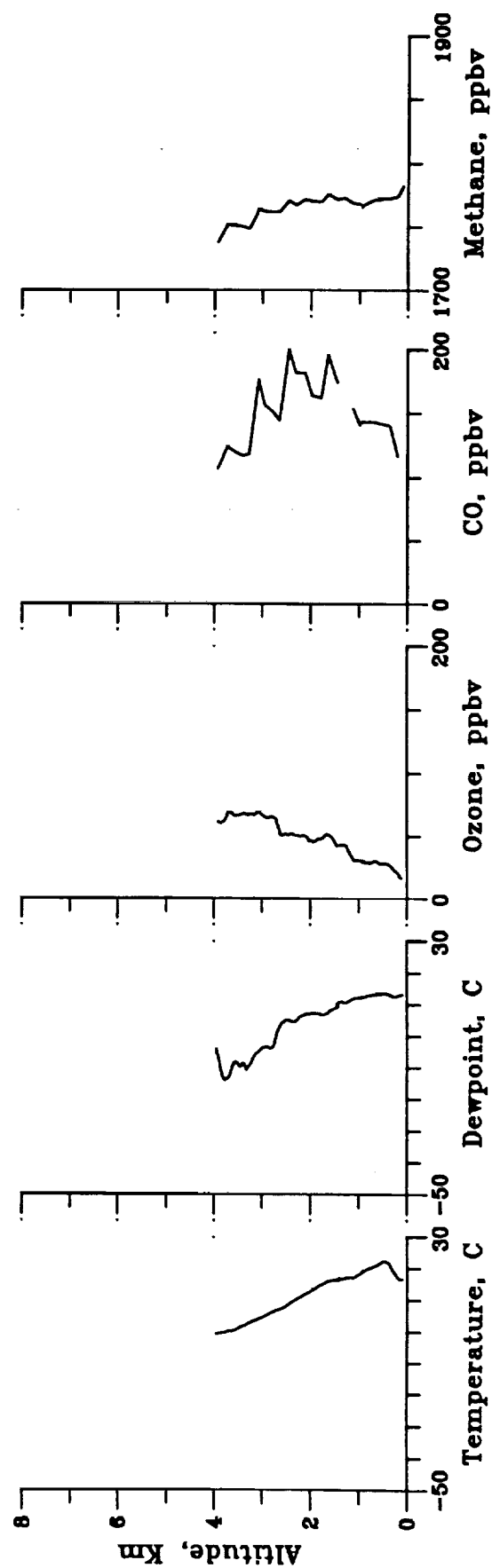


Figure B10.5

# ABLE-3B CANADIAN MISSION: FLIGHT 11.

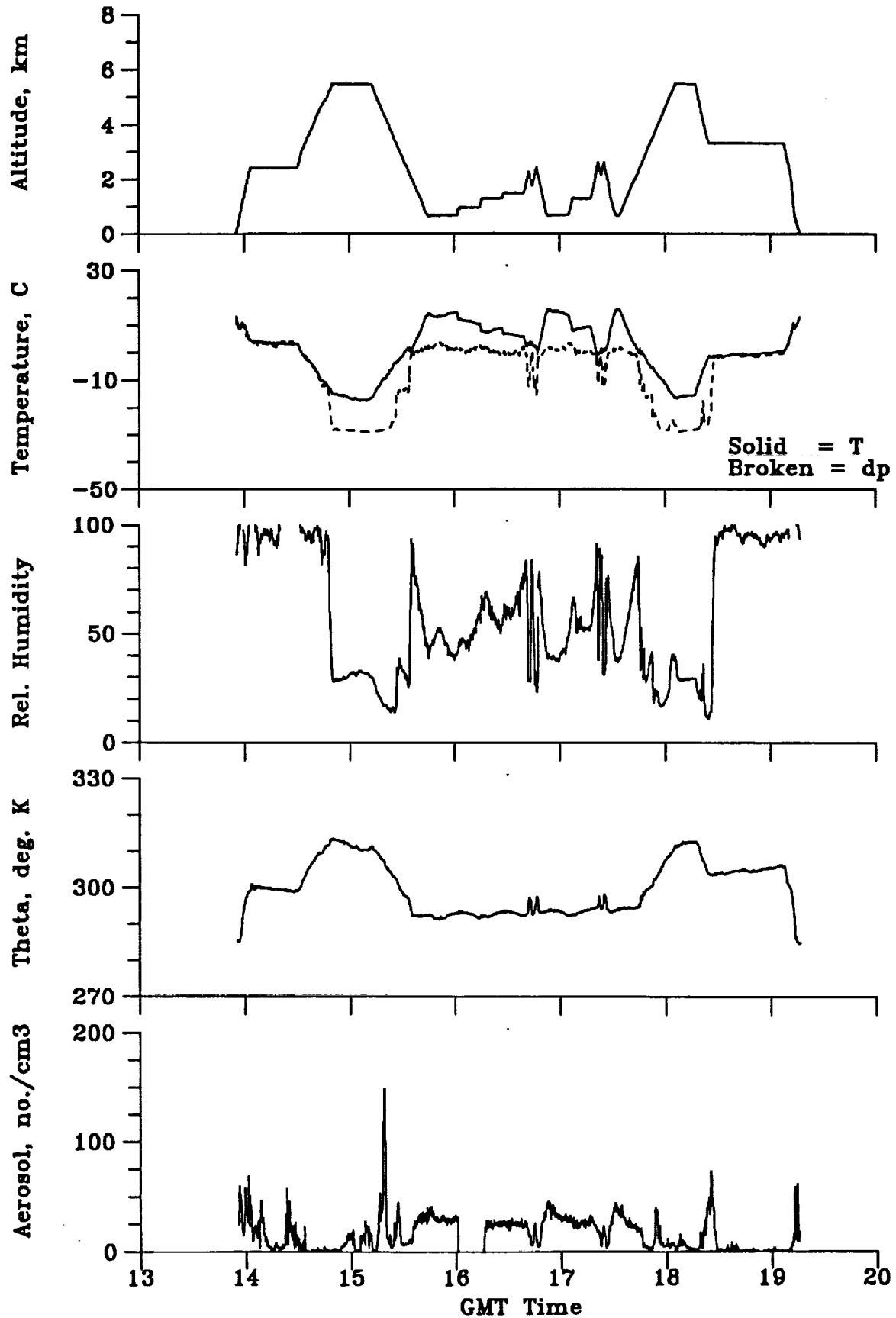


Figure B11.1

# ABLE-3B CANADIAN MISSION: FLIGHT 11.

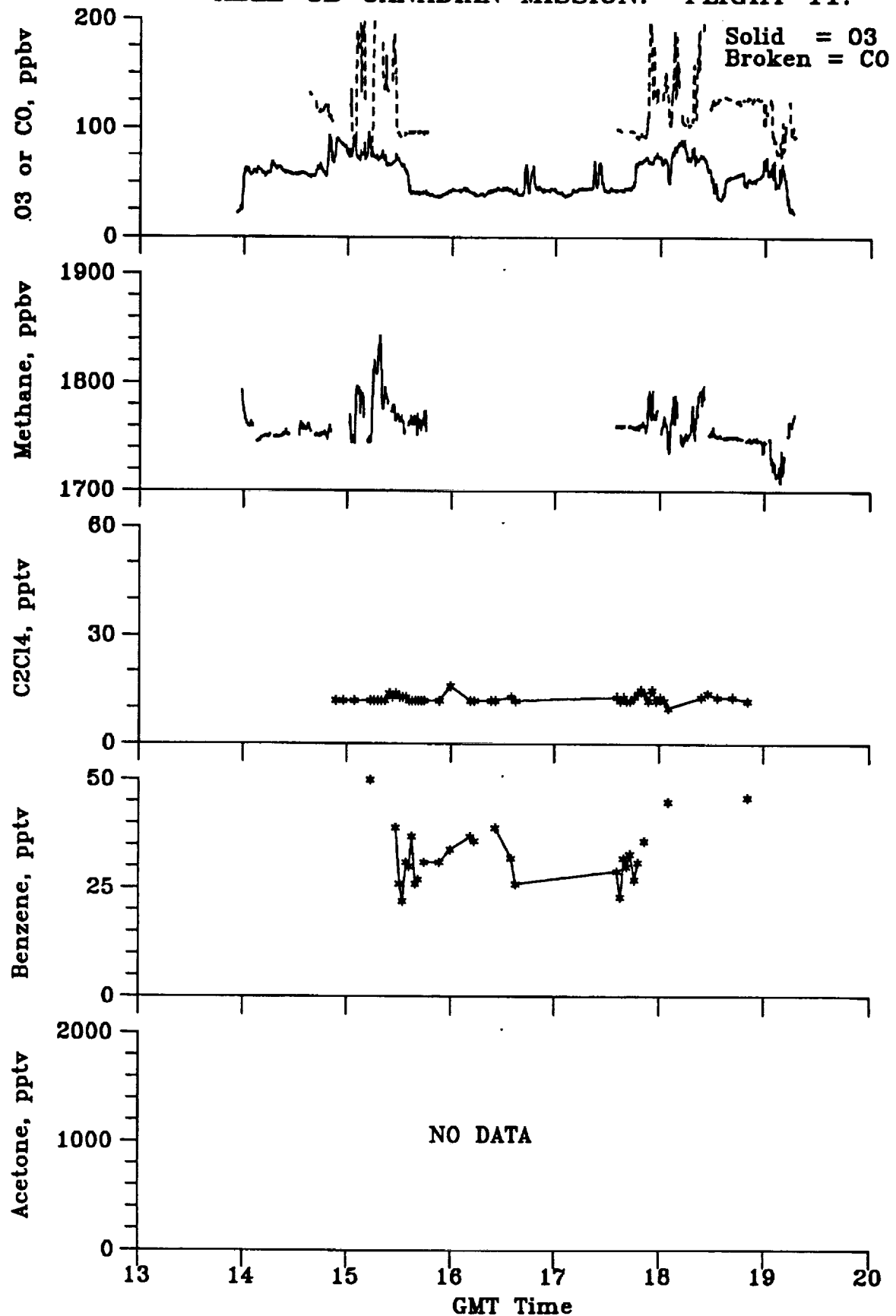


Figure B11.2

ABLE-3B CANADIAN MISSION: FLIGHT 11.

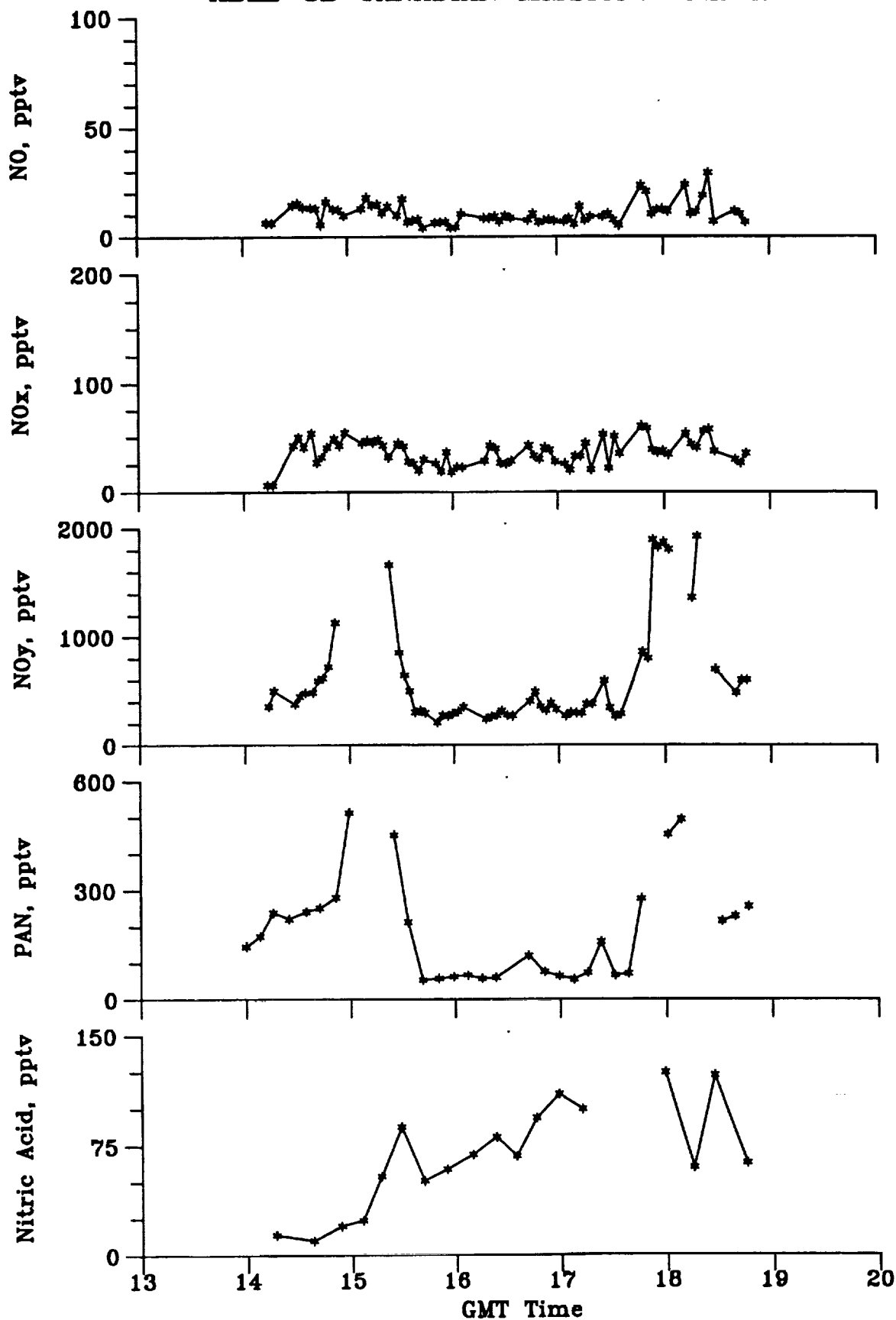


Figure B11.3

ABLE-3B CANADIAN MISSION: FLIGHT 11.

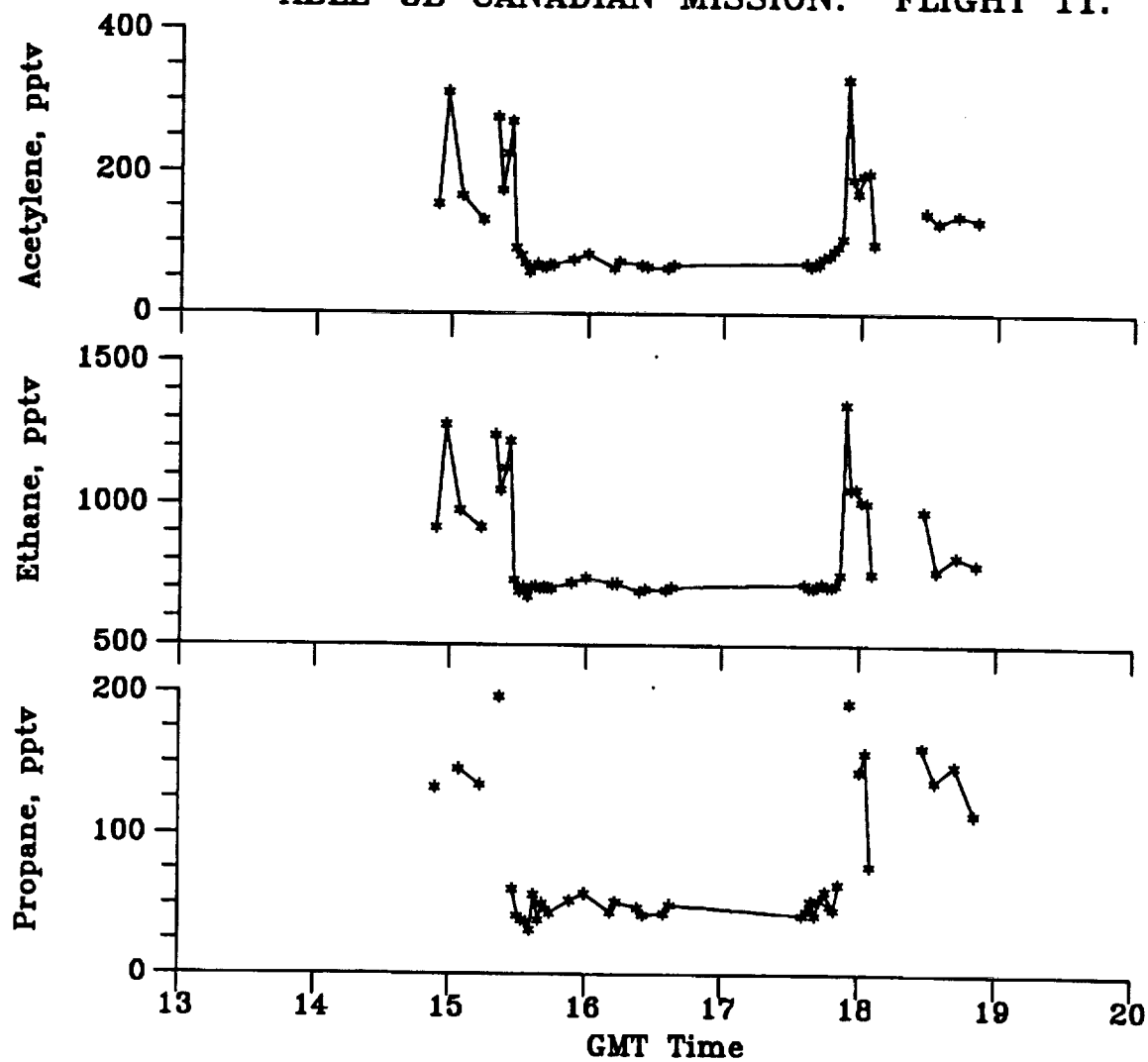
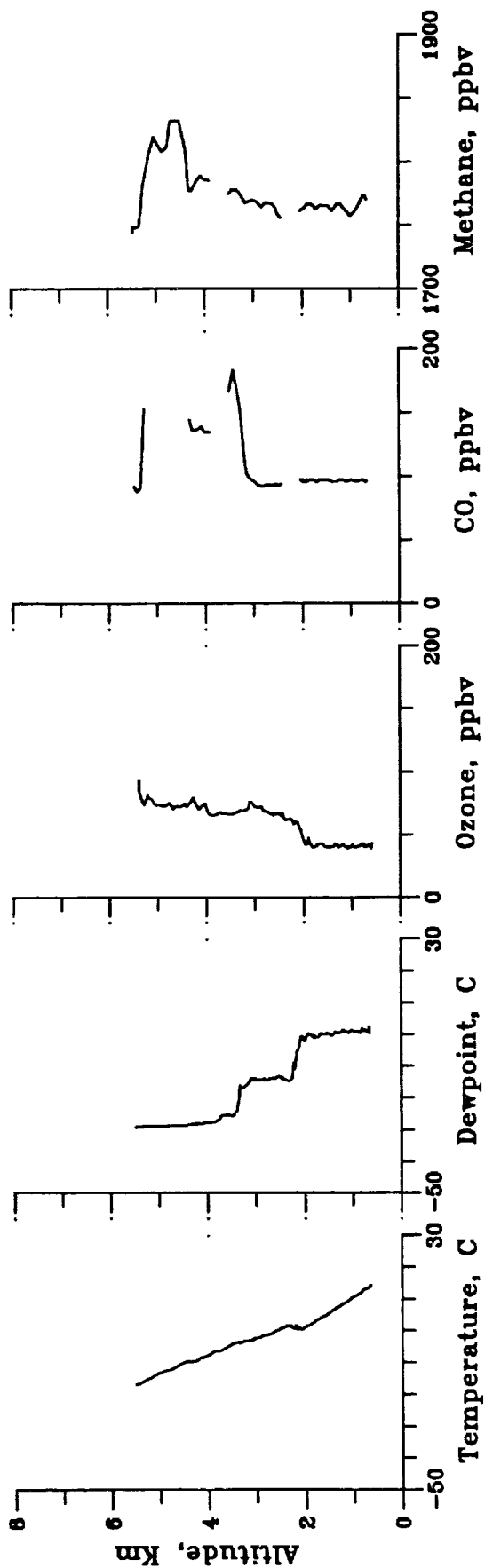


Figure B11.4

ABLE-3B CANADIAN MISSION: FLIGHT 11 PROFILE AT 1530 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 11 PROFILE AT 1730 GMT

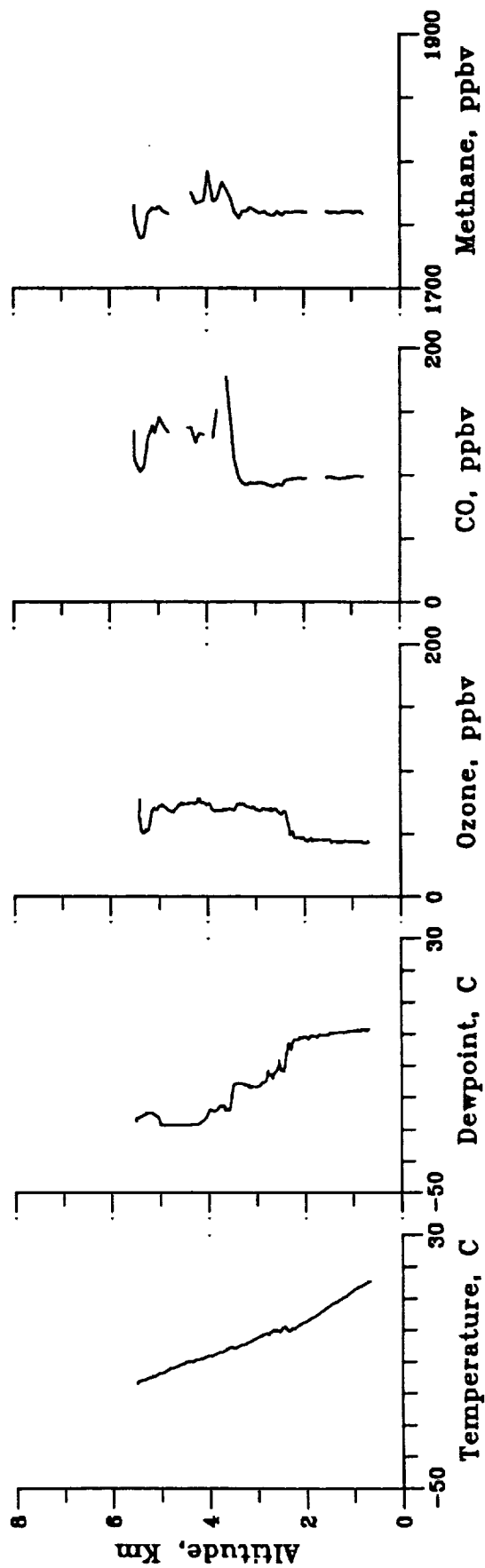


Figure B11.5



# ABLE-3B CANADIAN MISSION: FLIGHT 12.

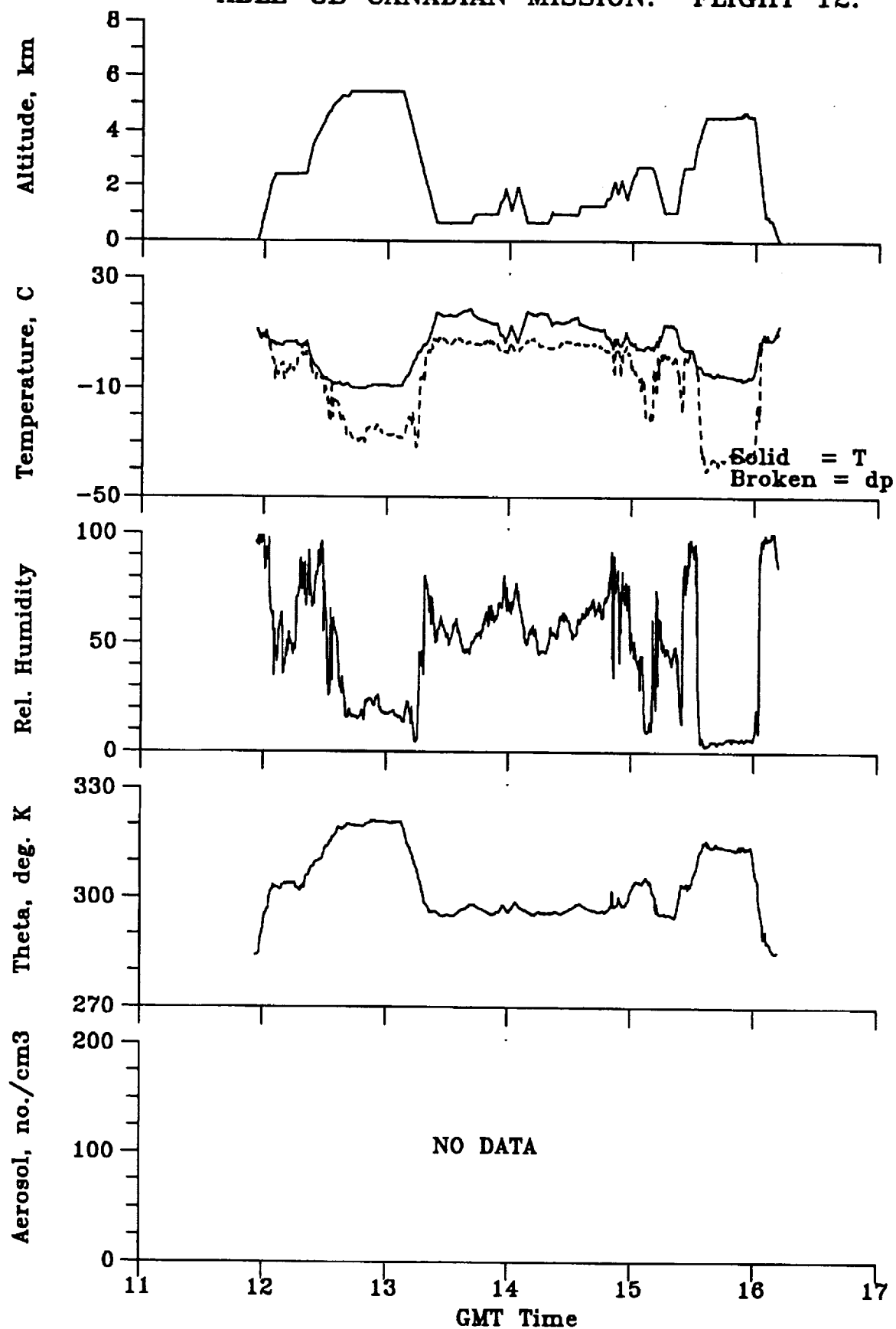


Figure B12.1

# ABLE-3B CANADIAN MISSION: FLIGHT 12.

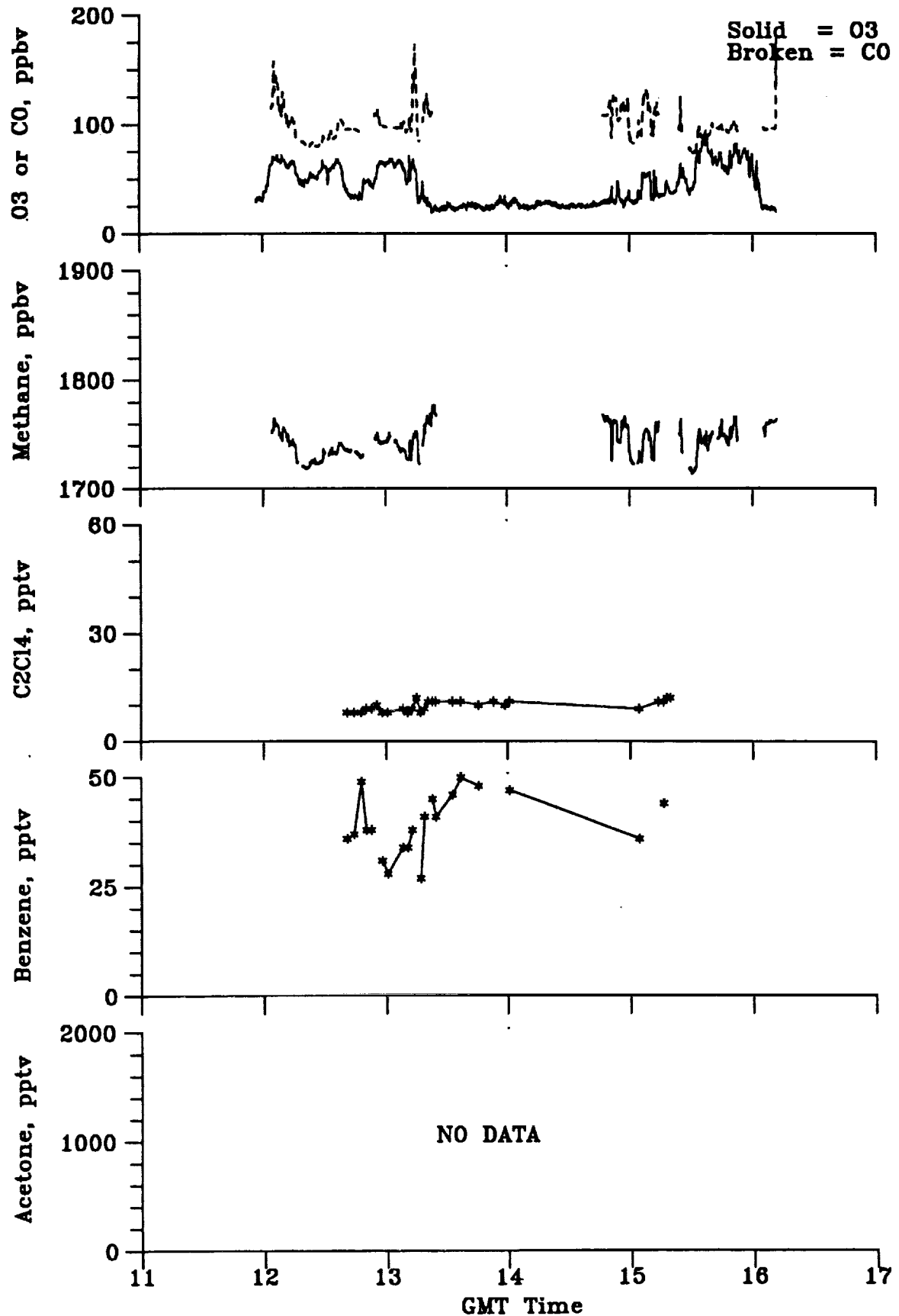


Figure B12.2

ABLE-3B CANADIAN MISSION: FLIGHT 12.

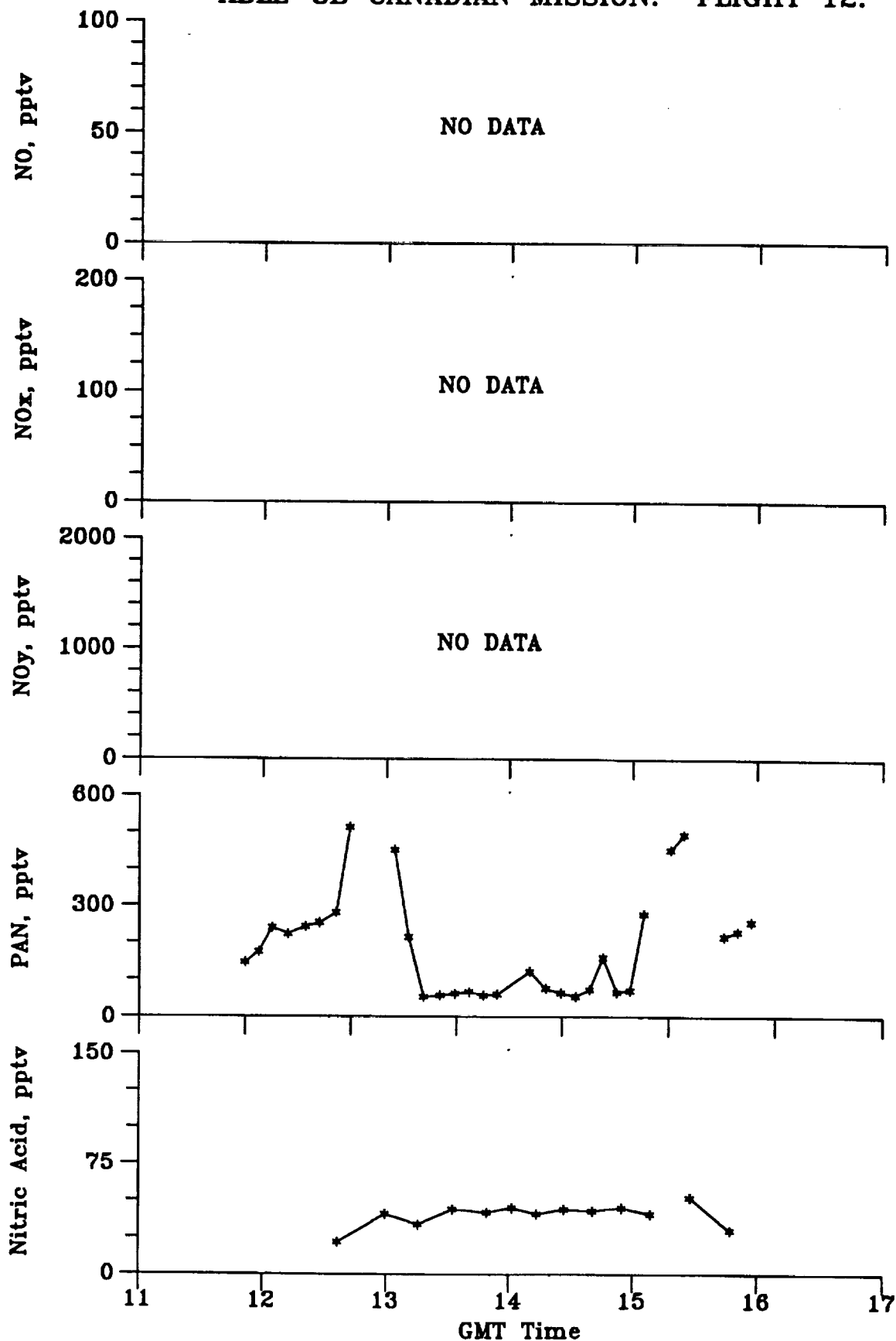


Figure B12.3

ABLE-3B CANADIAN MISSION: FLIGHT 12.

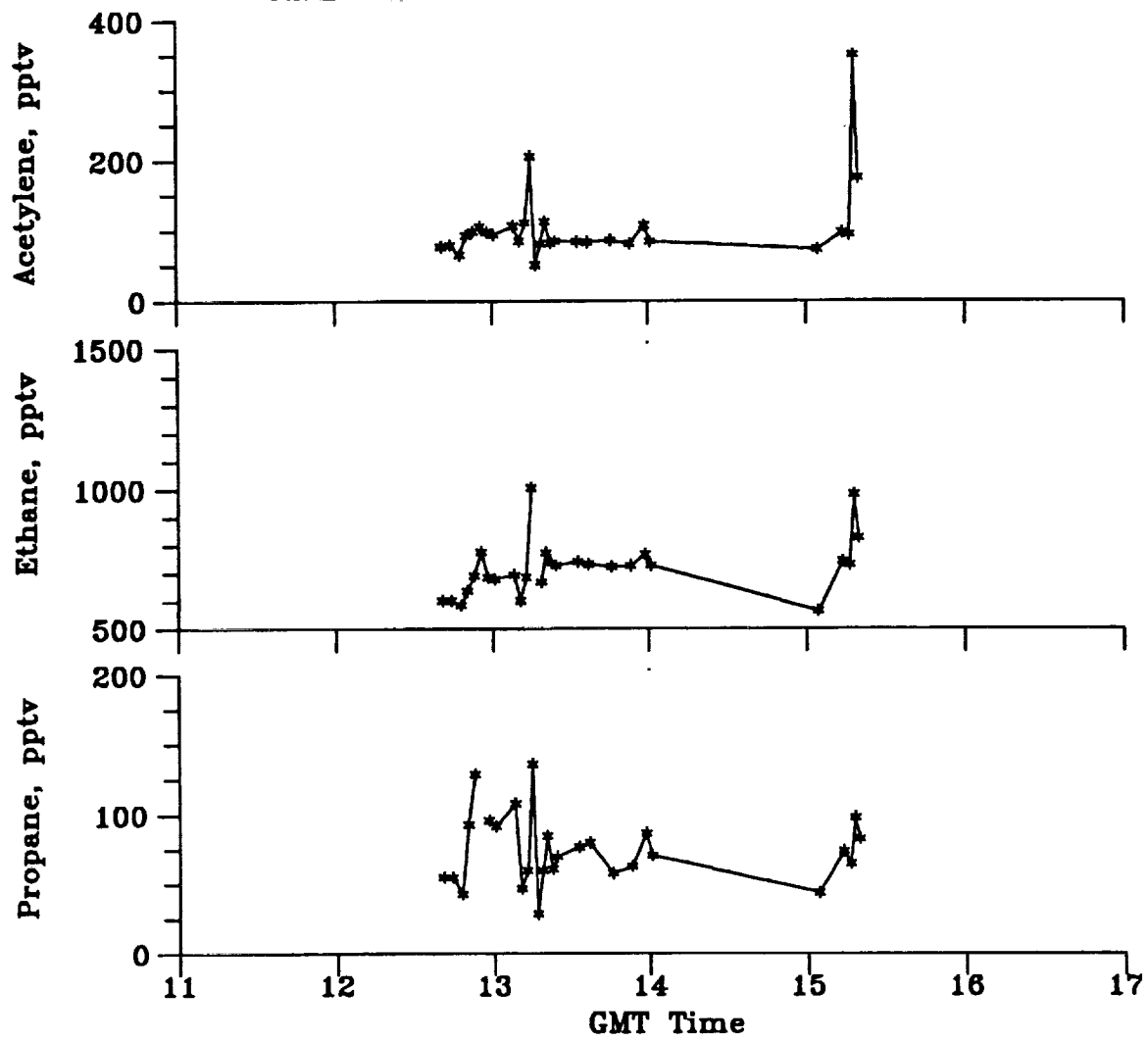
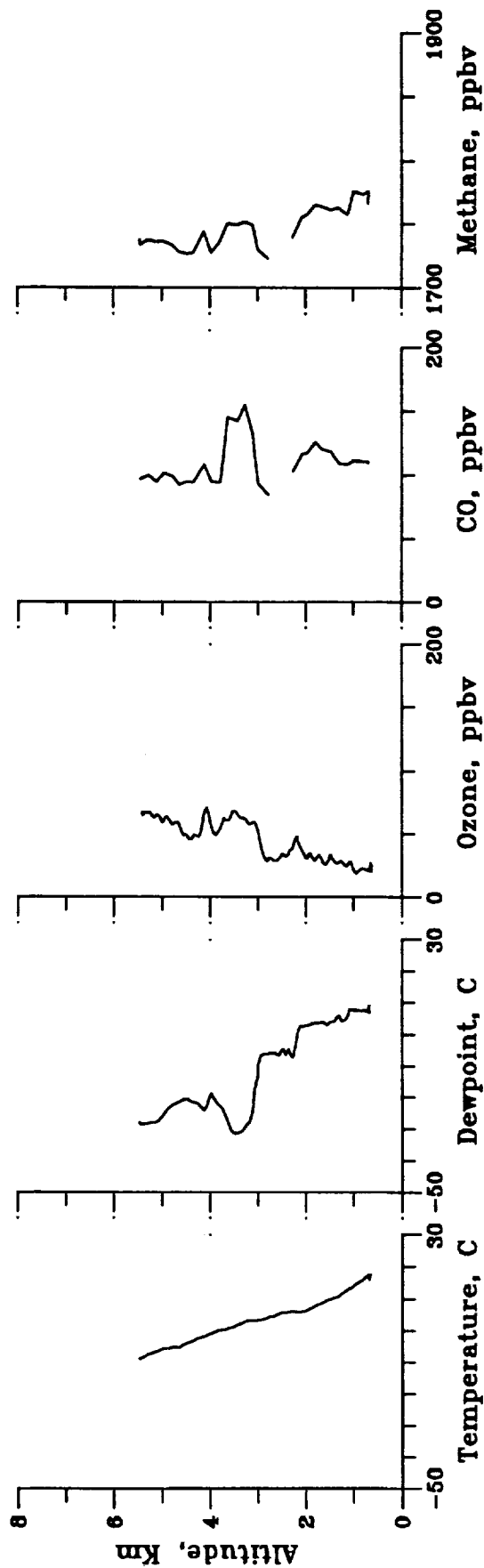


Figure B12.4

ABLE-3B CANADIAN MISSION: FLIGHT 12 PROFILE AT 1315 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 12 PROFILE AT 1600 GMT

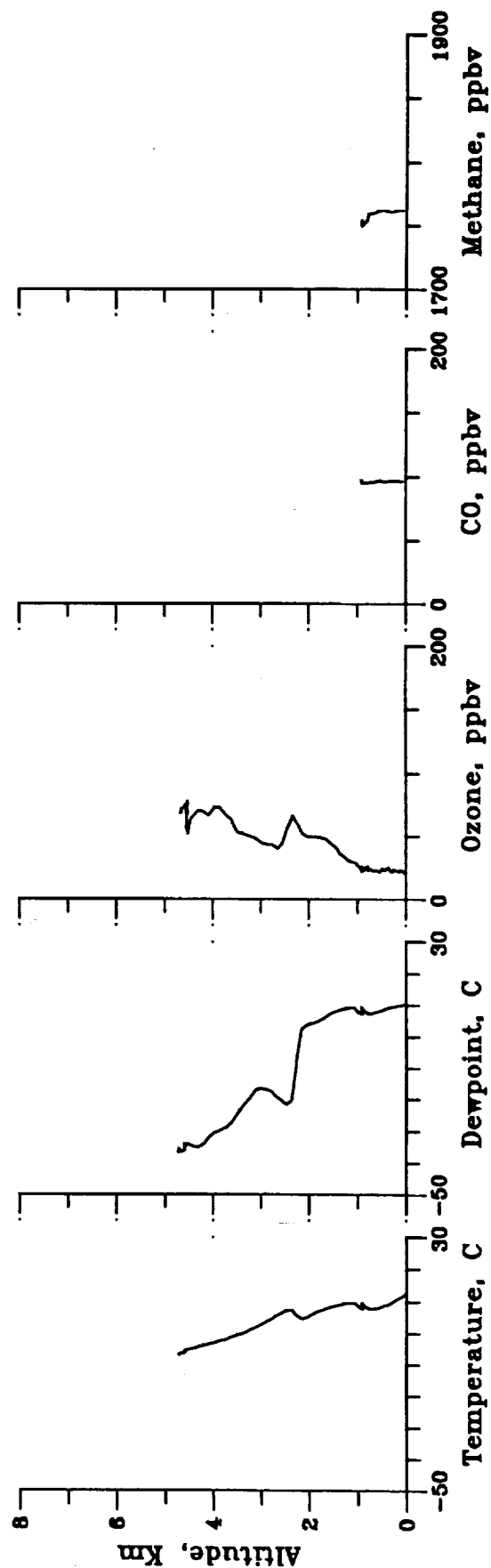


Figure B12.5

# ABLE-3B CANADIAN MISSION: FLIGHT 13.

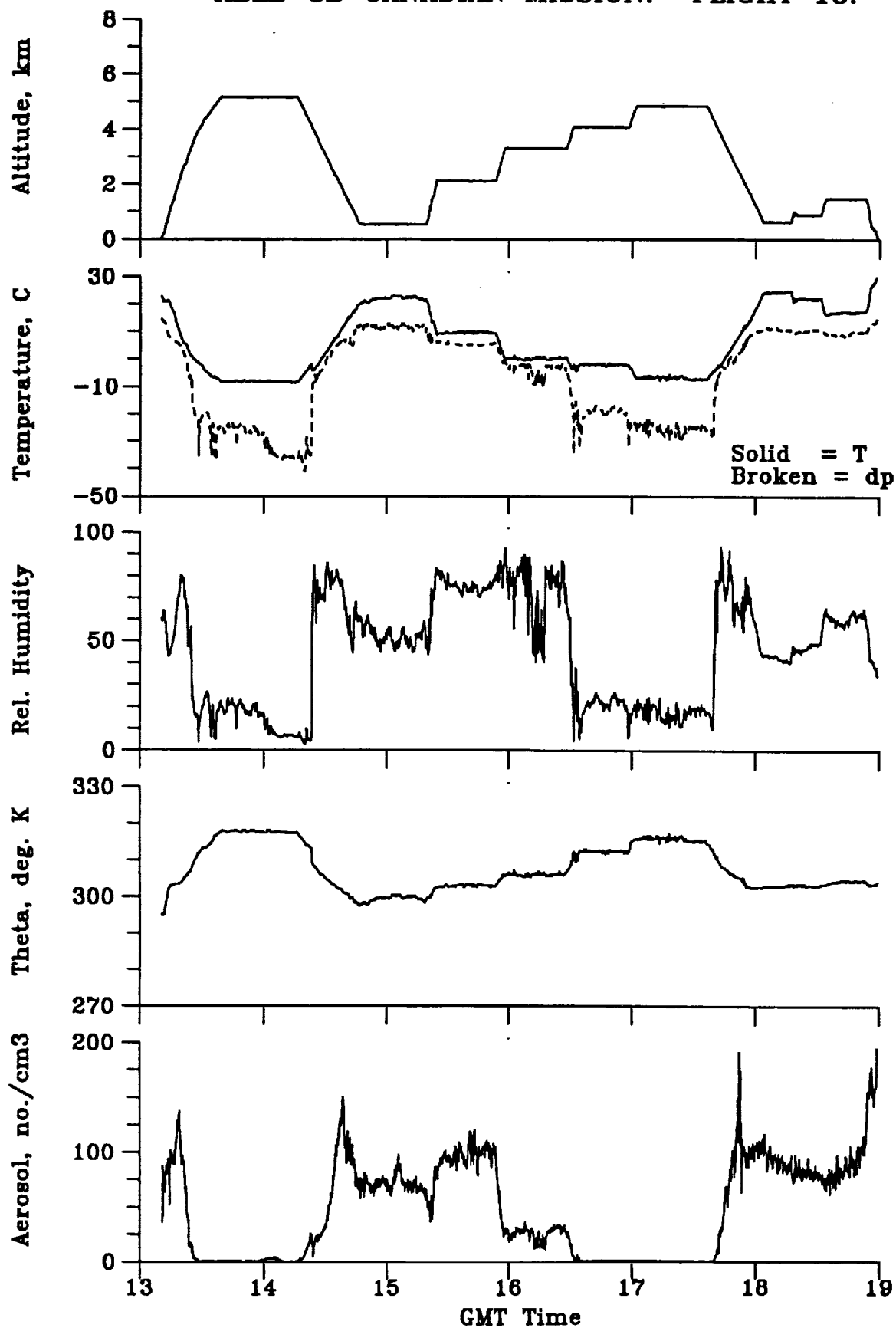


Figure B13.1

# ABLE-3B CANADIAN MISSION: FLIGHT 13.

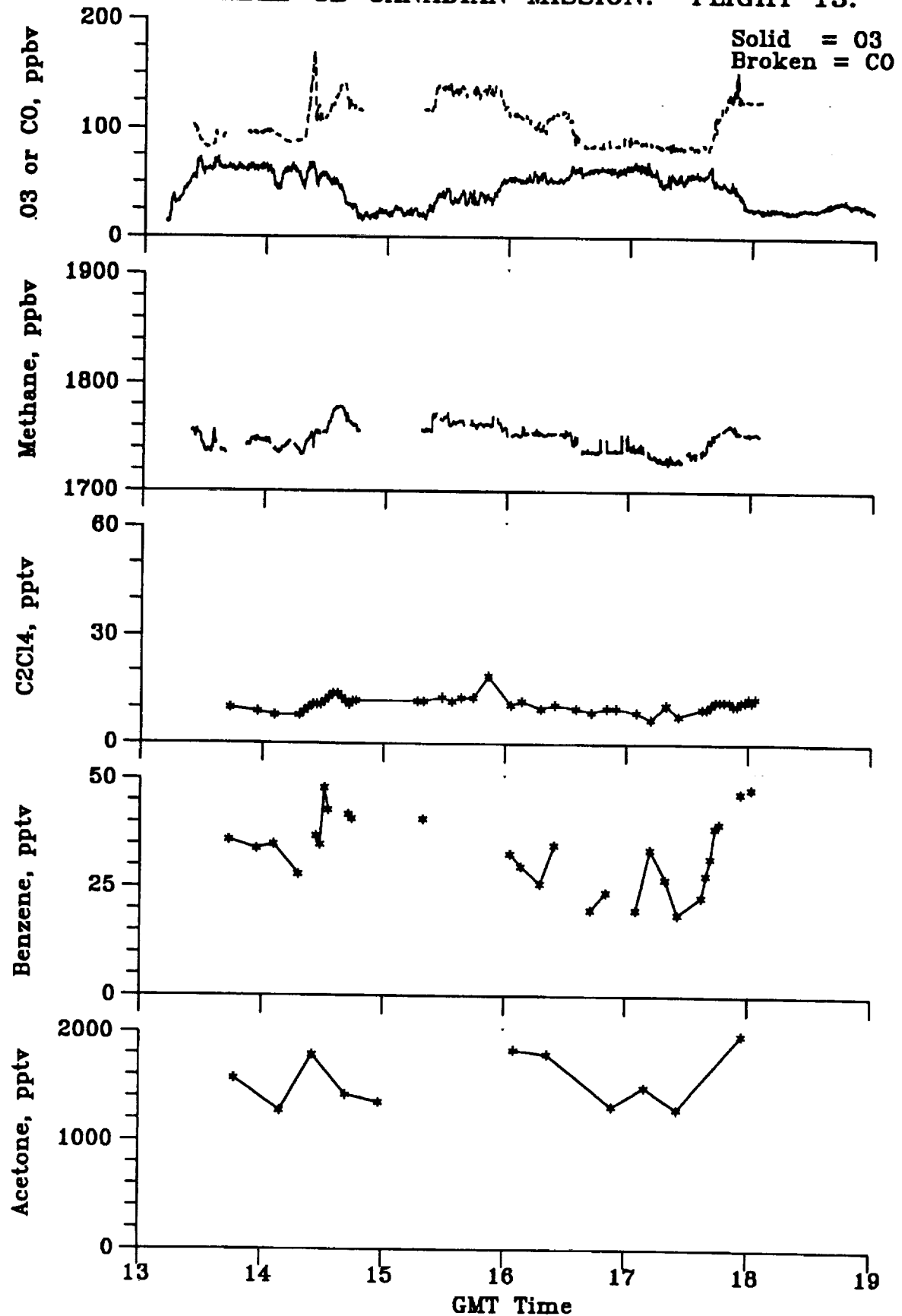


Figure B13.2

ABLE-3B CANADIAN MISSION: FLIGHT 13.

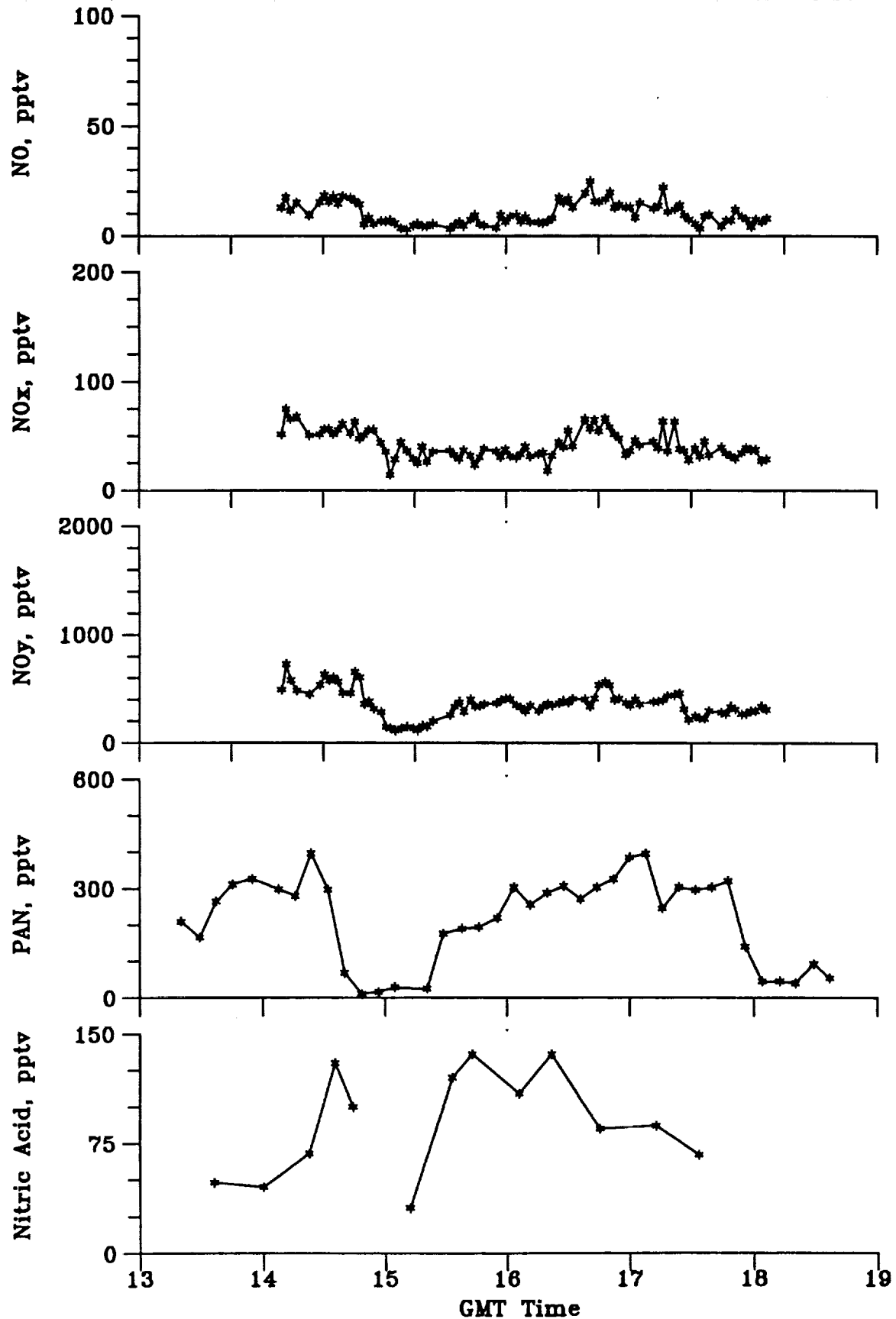


Figure B13.3



ABLE-3B CANADIAN MISSION: FLIGHT 13.

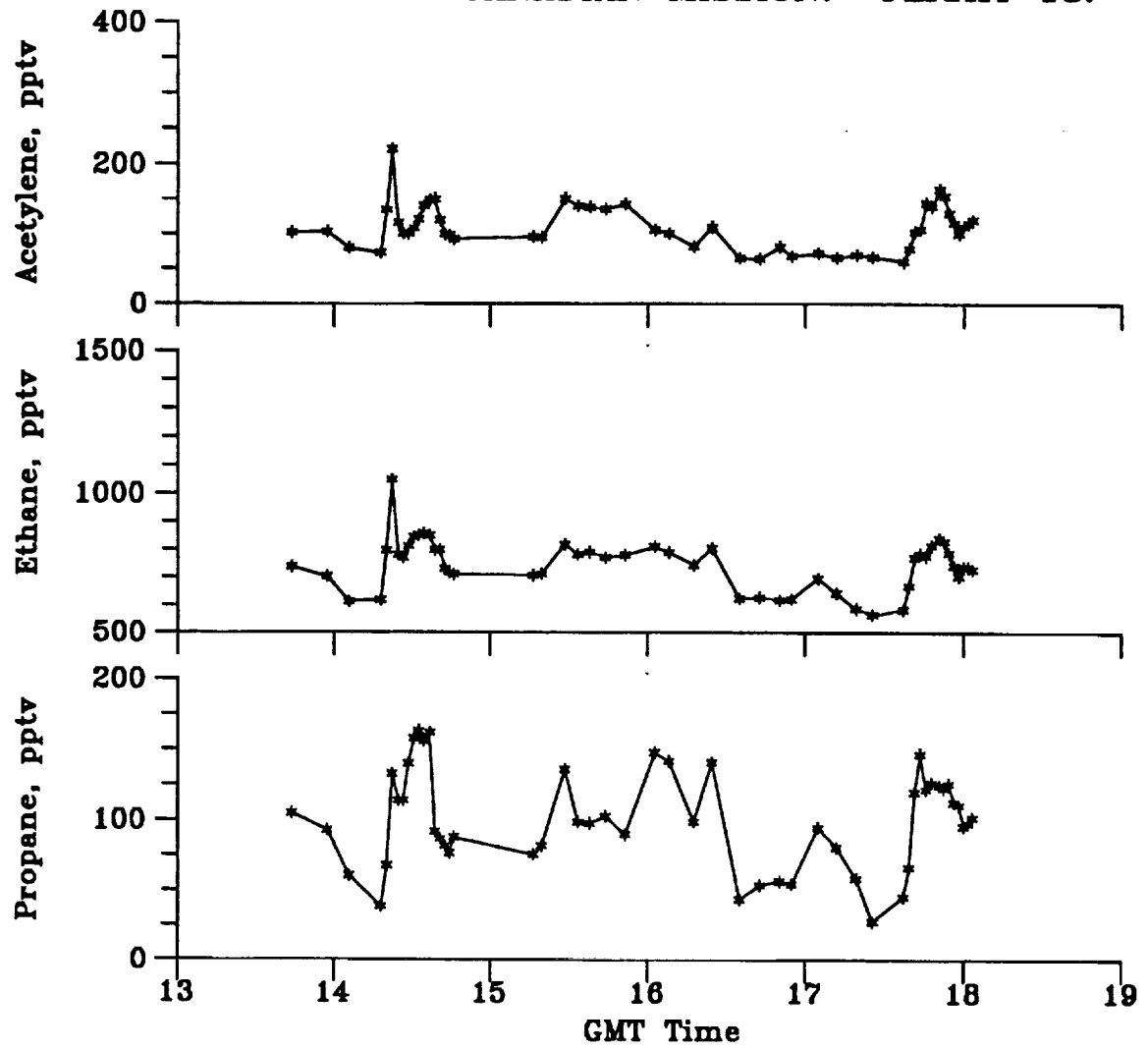
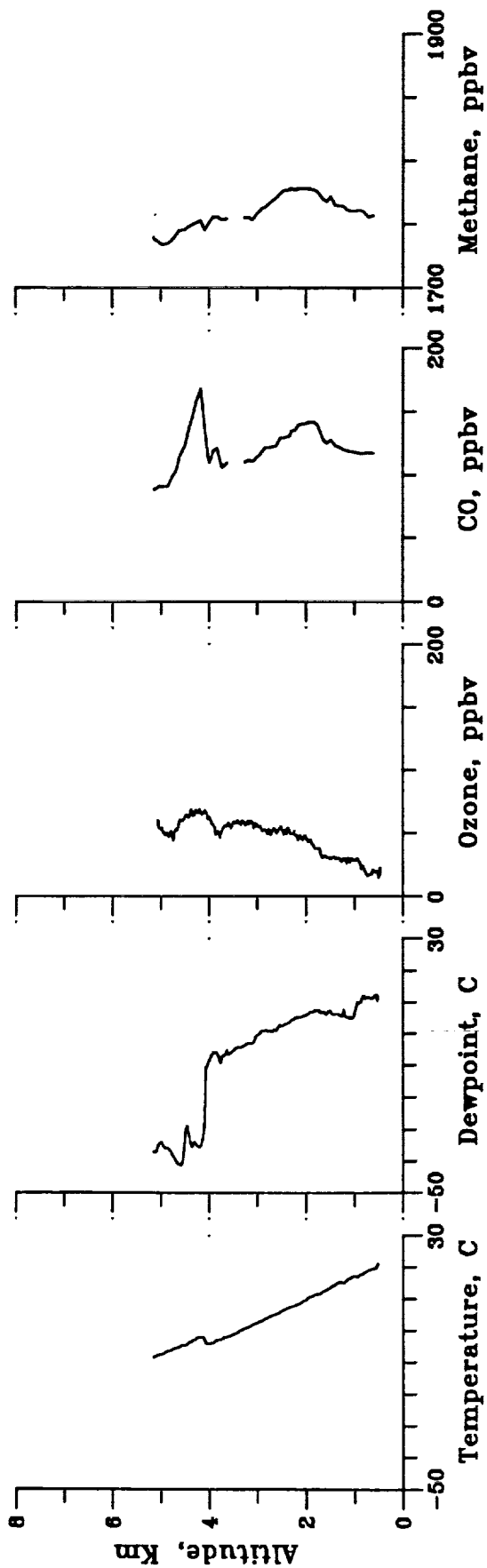


Figure B13.4

ABLE-3B CANADIAN MISSION: FLIGHT 13 PROFILE AT 1430 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 13 PROFILE AT 1745 GMT

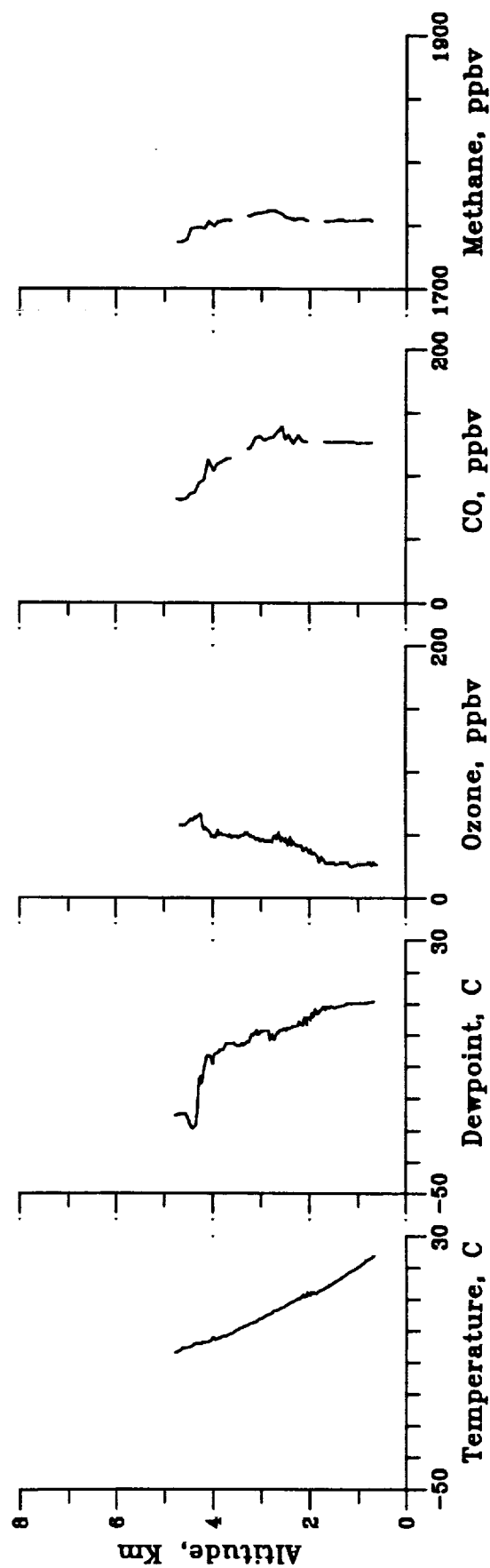


Figure B13.5

# ABLE-3B CANADIAN MISSION: FLIGHT 14.

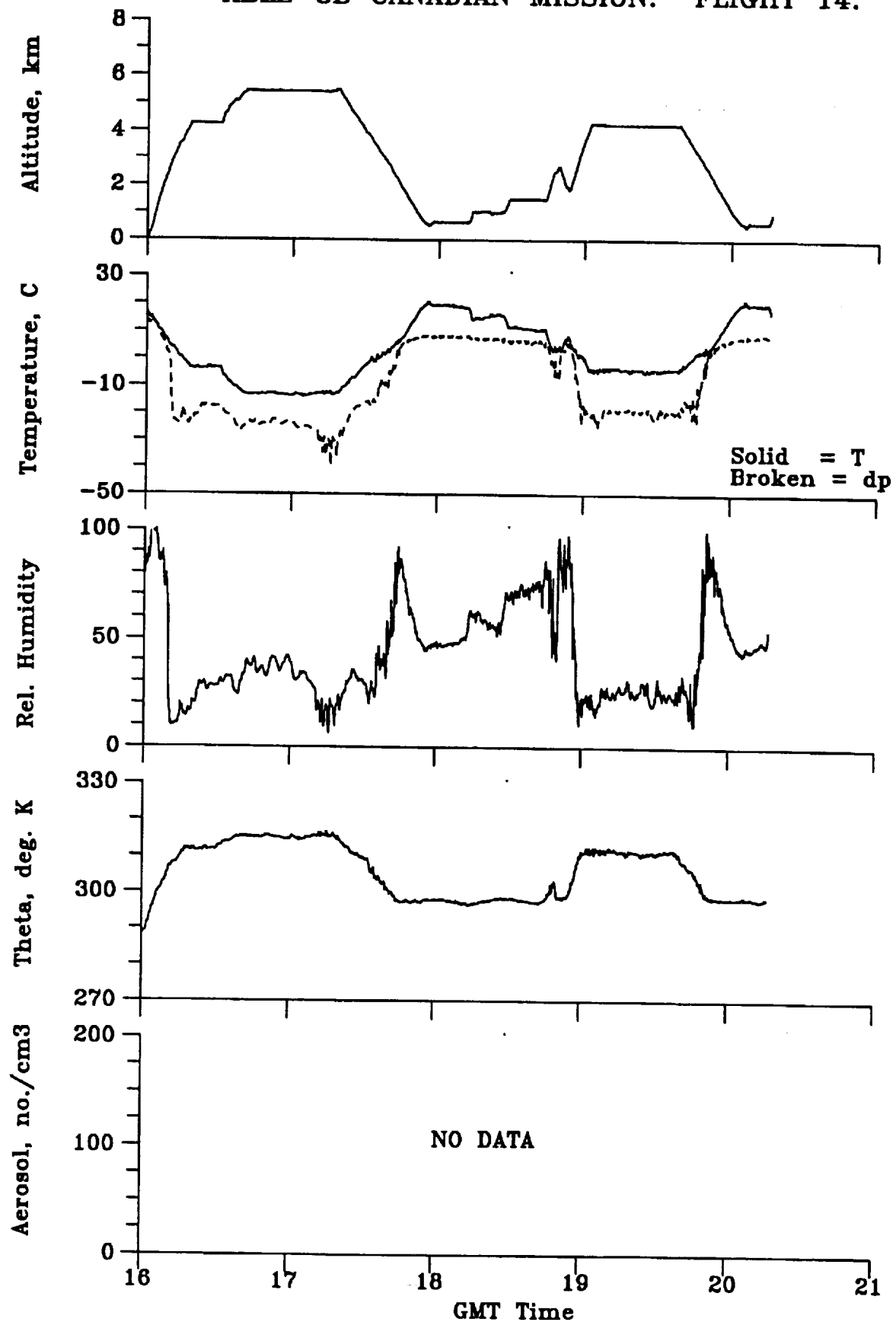


Figure B14.1

# ABLE-3B CANADIAN MISSION: FLIGHT 14.

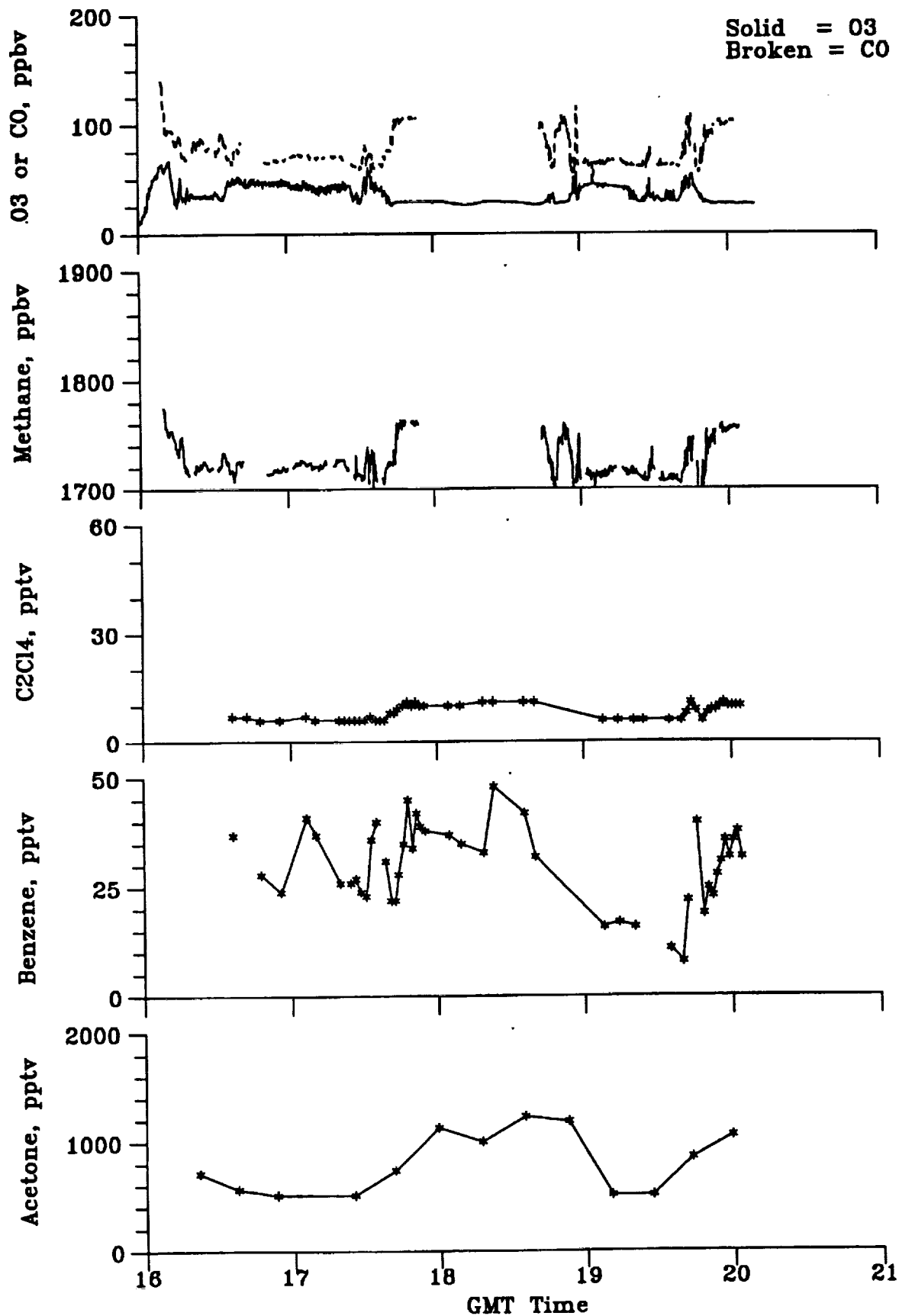


Figure B14.2

ABLE-3B CANADIAN MISSION: FLIGHT 14.

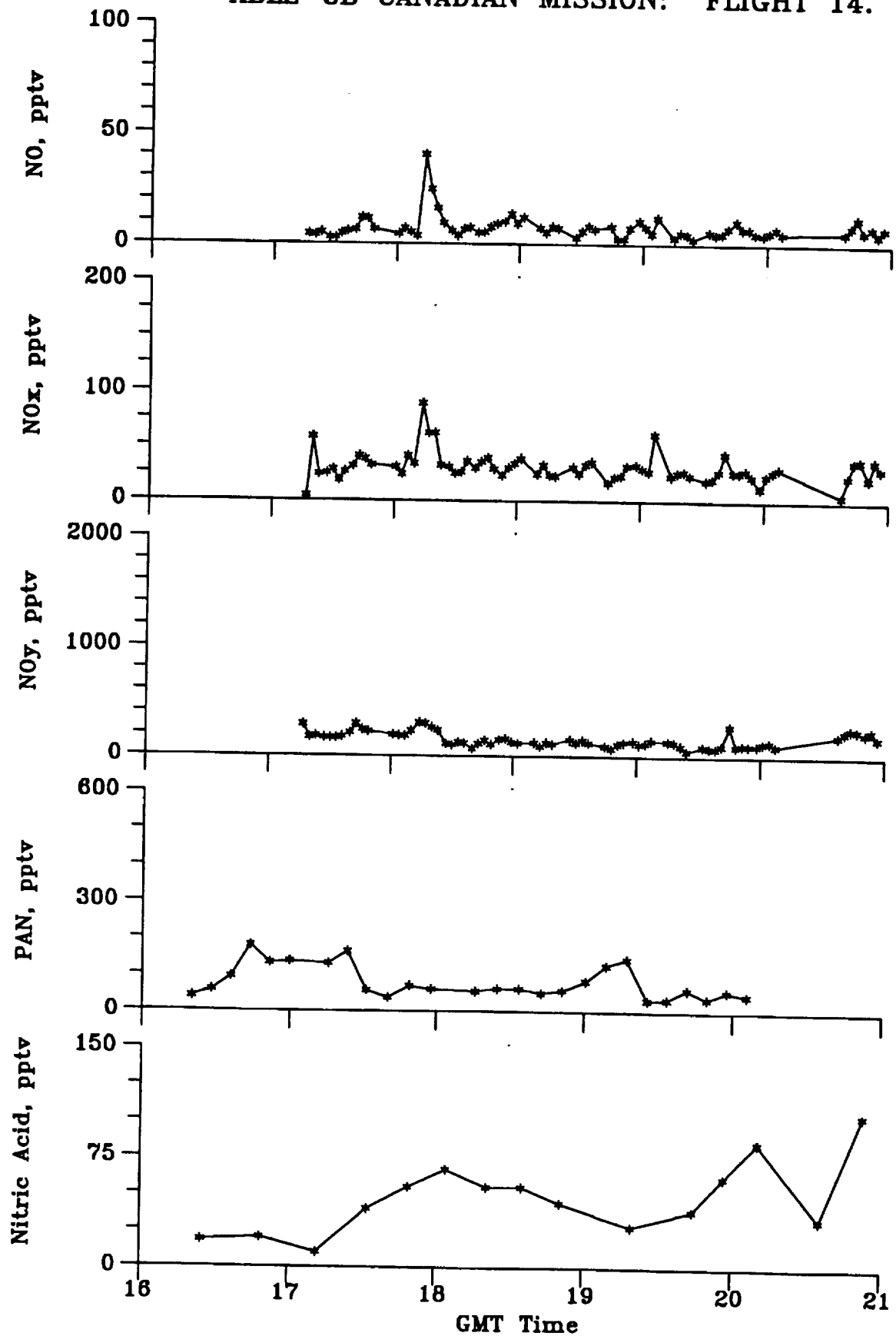


Figure B14.3

ABLE-3B CANADIAN MISSION: FLIGHT 14.

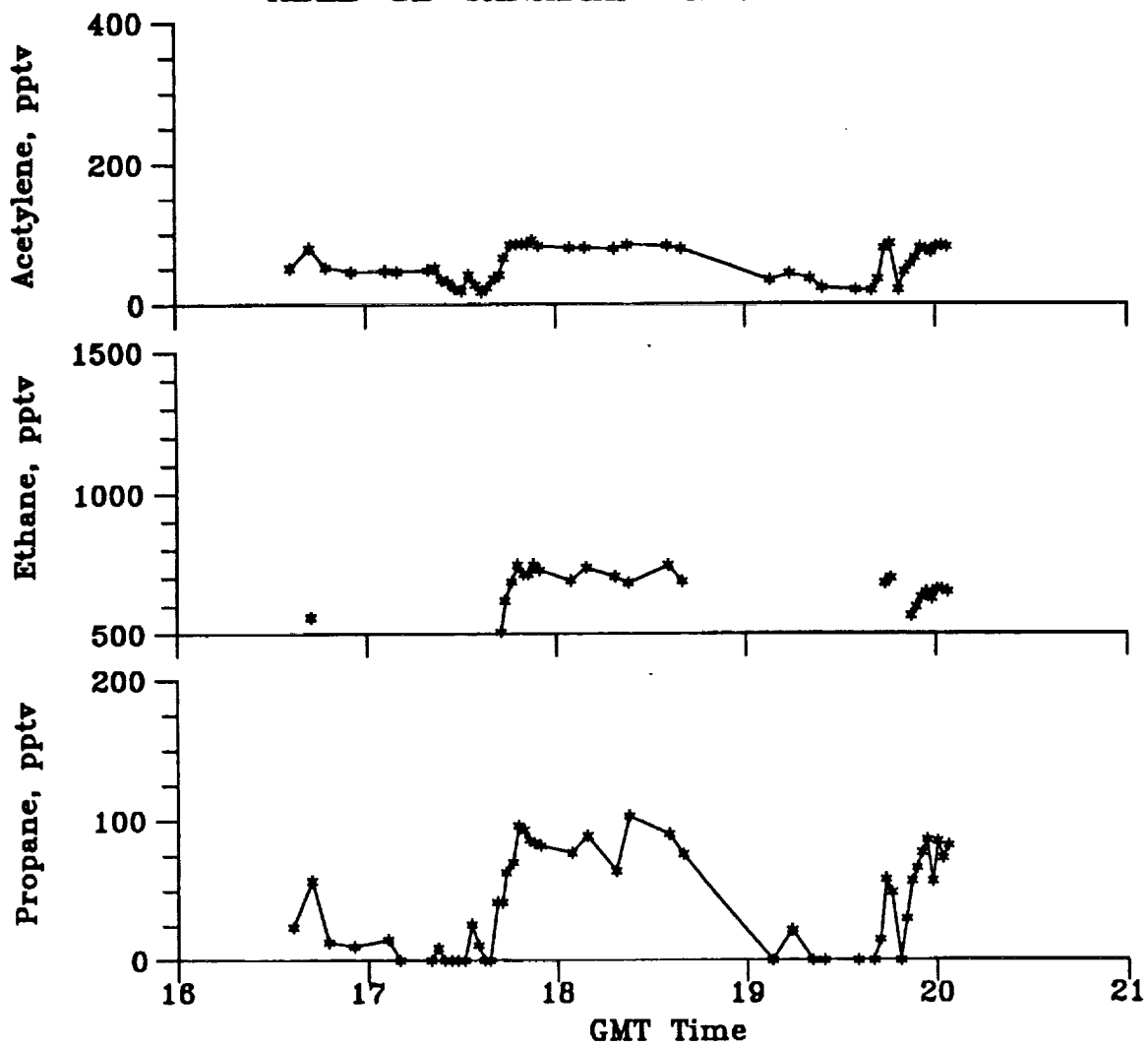
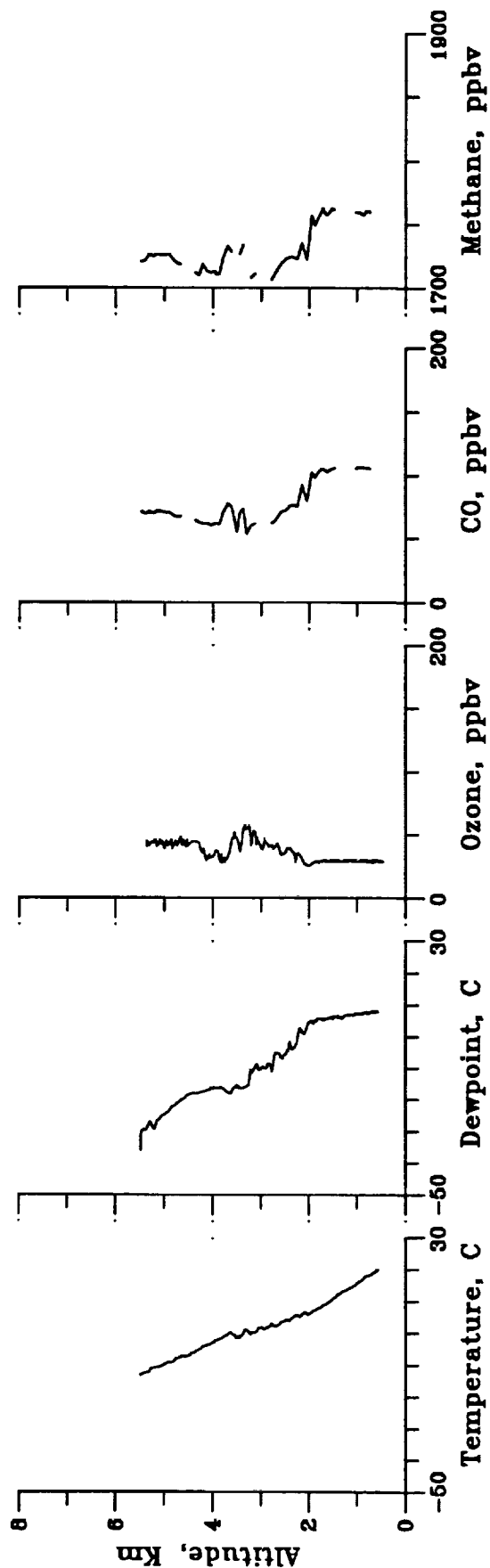


Figure B14.4

ABLE-3B CANADIAN MISSION: FLIGHT 14 PROFILE AT 1730 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 14 PROFILE AT 1945 GMT

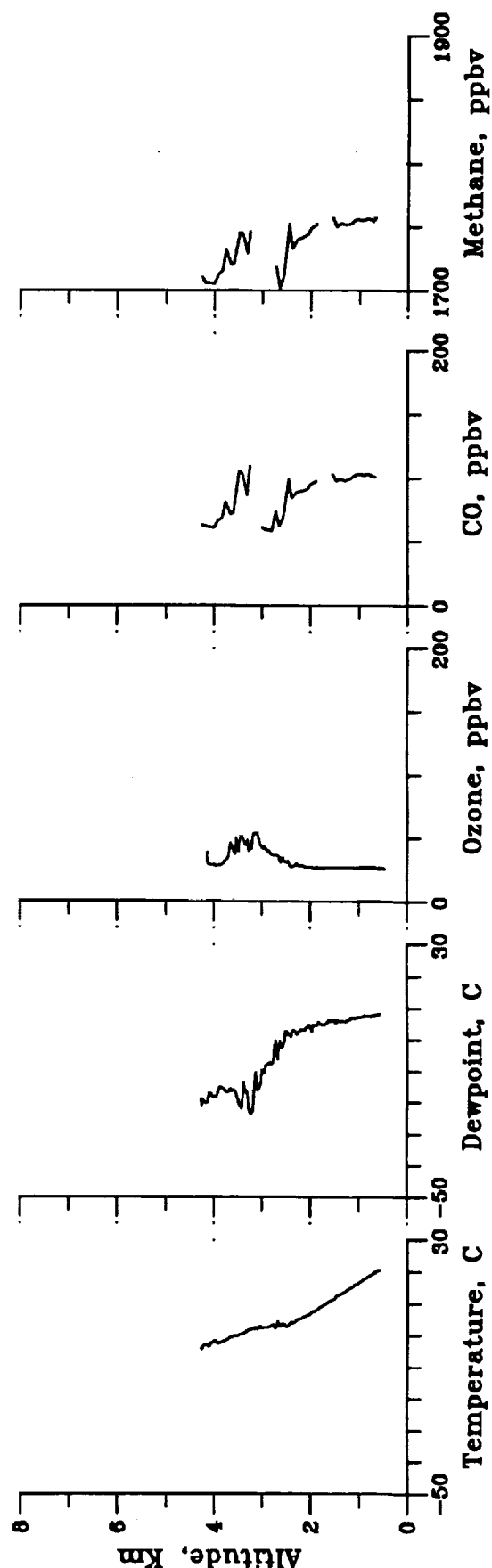


Figure B14.5

# ABLE-3B CANADIAN MISSION: FLIGHT 15.

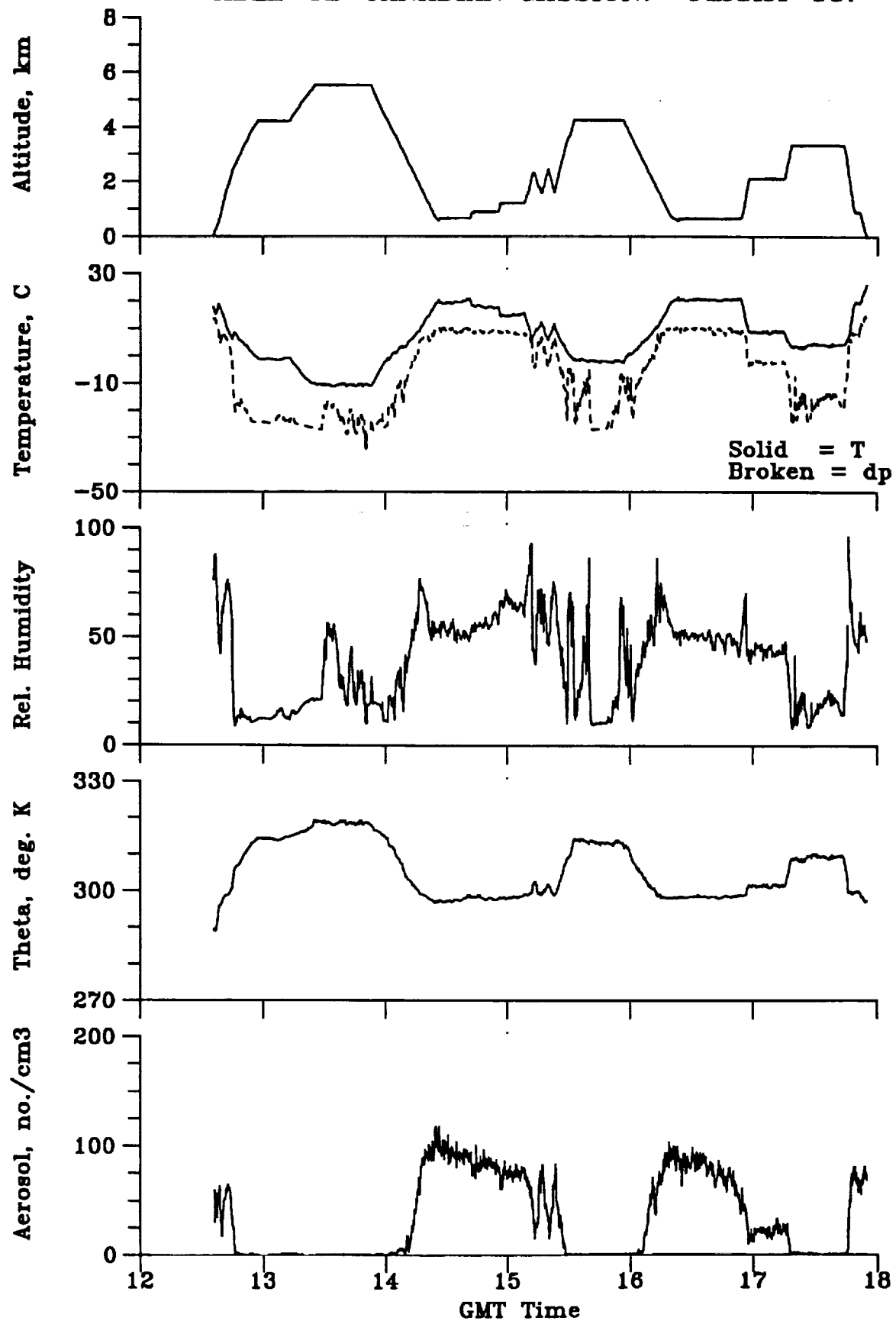


Figure B15.1



# ABLE-3B CANADIAN MISSION: FLIGHT 15.

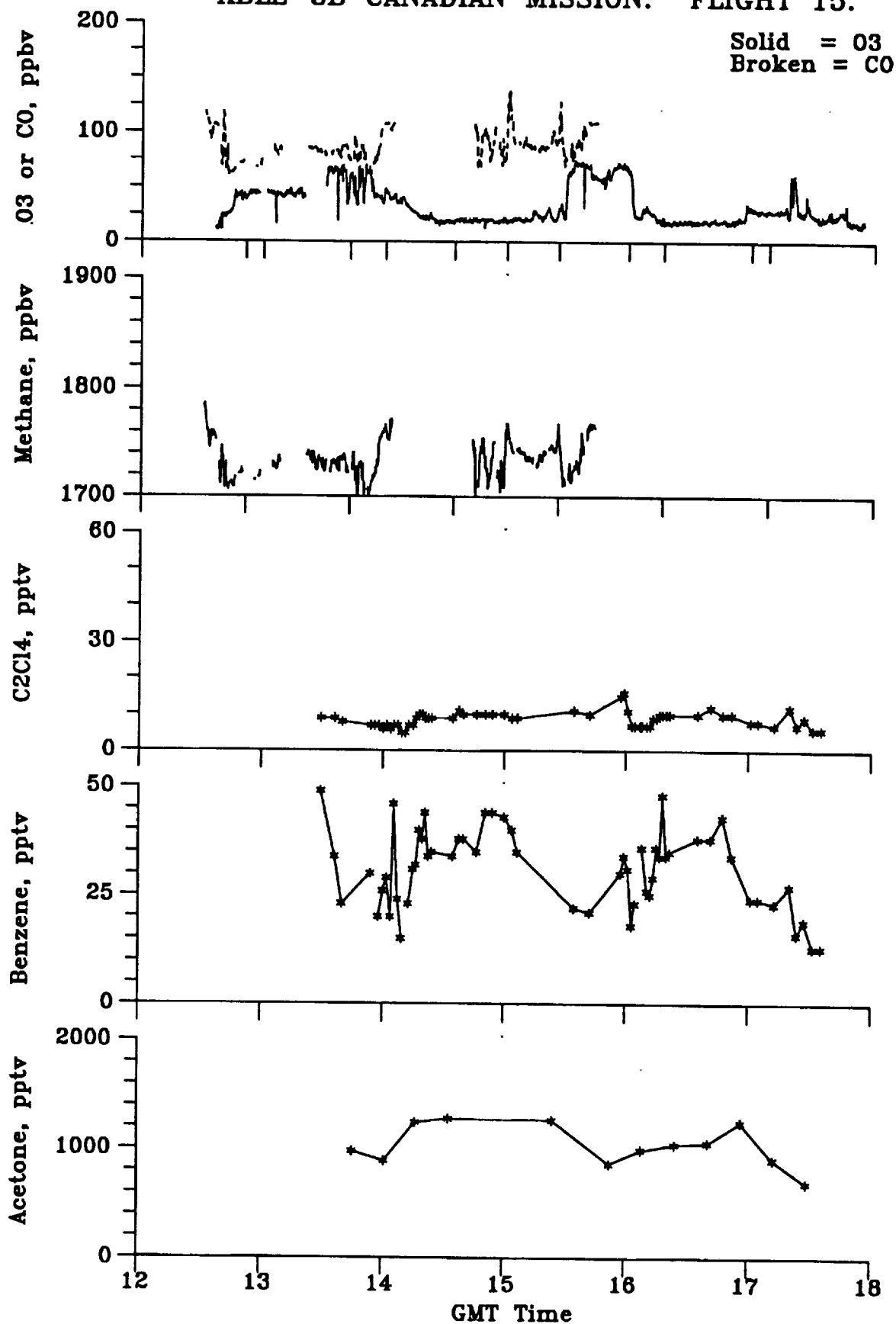


Figure B15.2

ABLE-3B CANADIAN MISSION: FLIGHT 15.

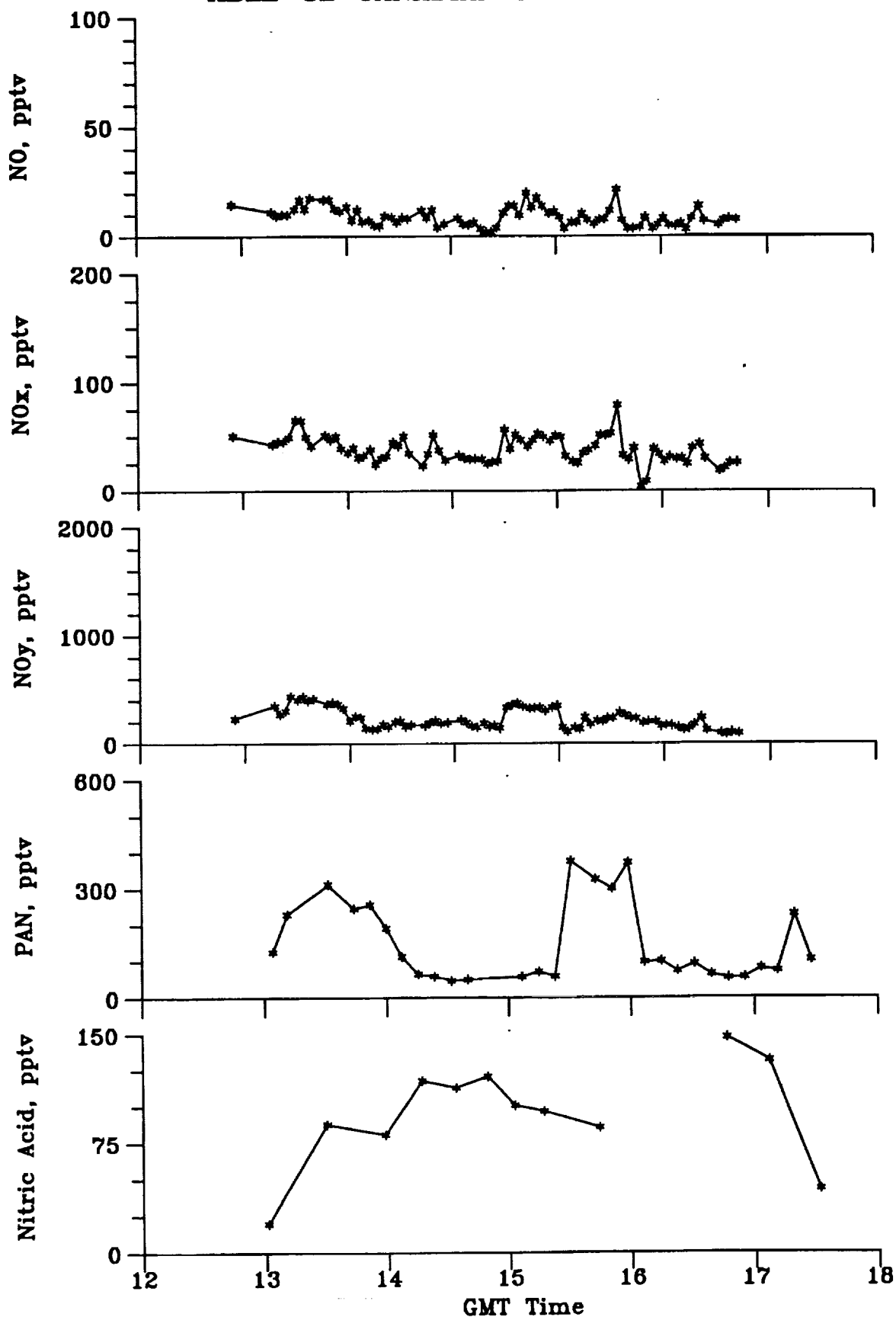


Figure B15.3

ABLE-3B CANADIAN MISSION: FLIGHT 15.

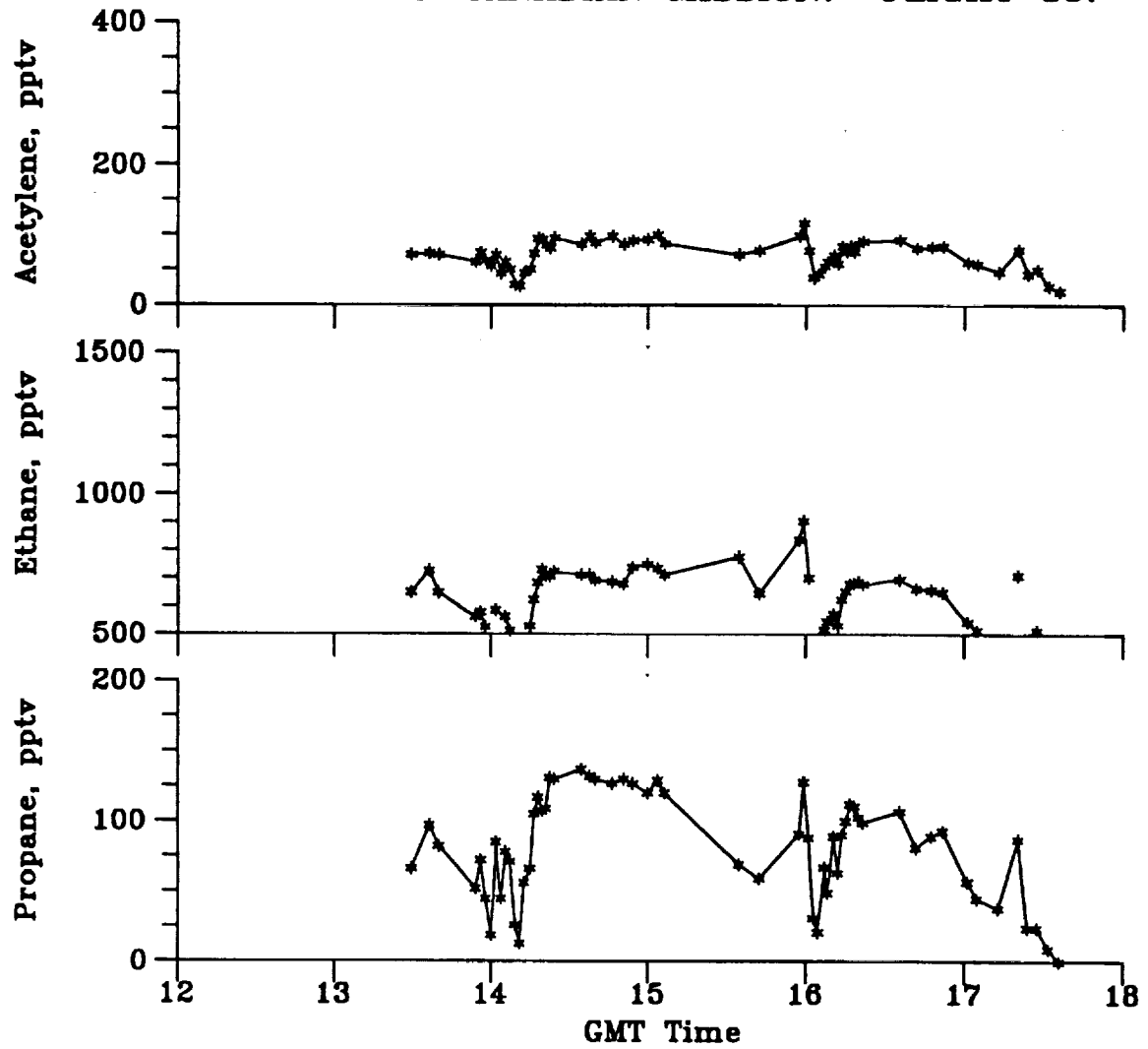
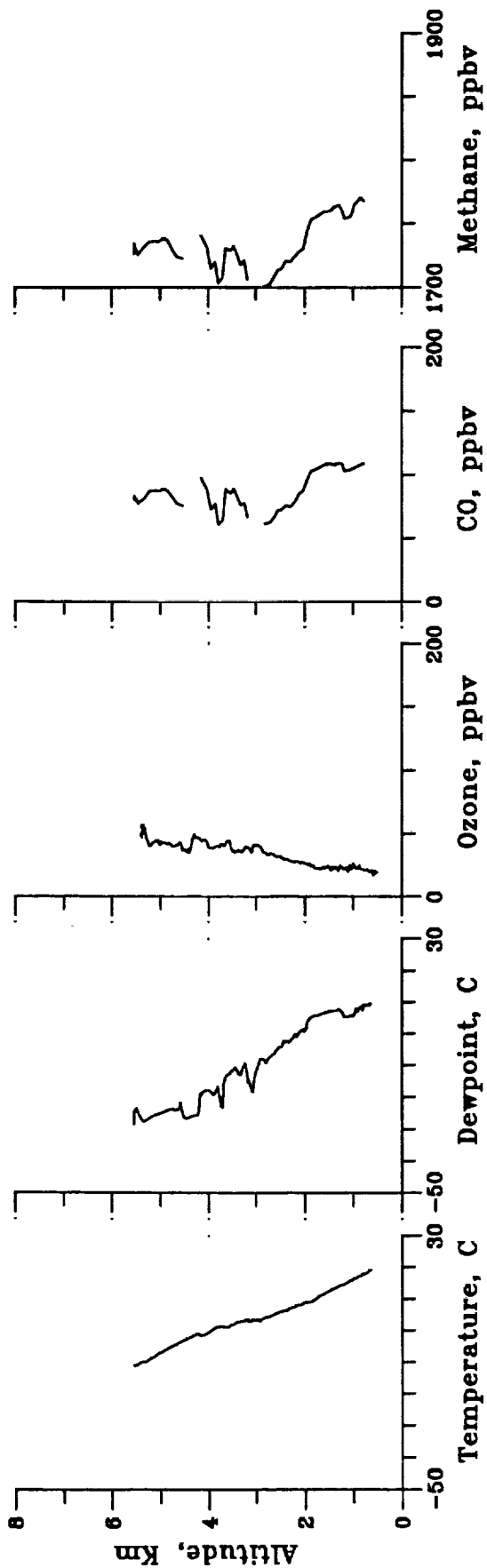


Figure B15.4

ABLE-3B CANADIAN MISSION: FLIGHT 15 PROFILE AT 1400 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 15 PROFILE AT 1615 GMT

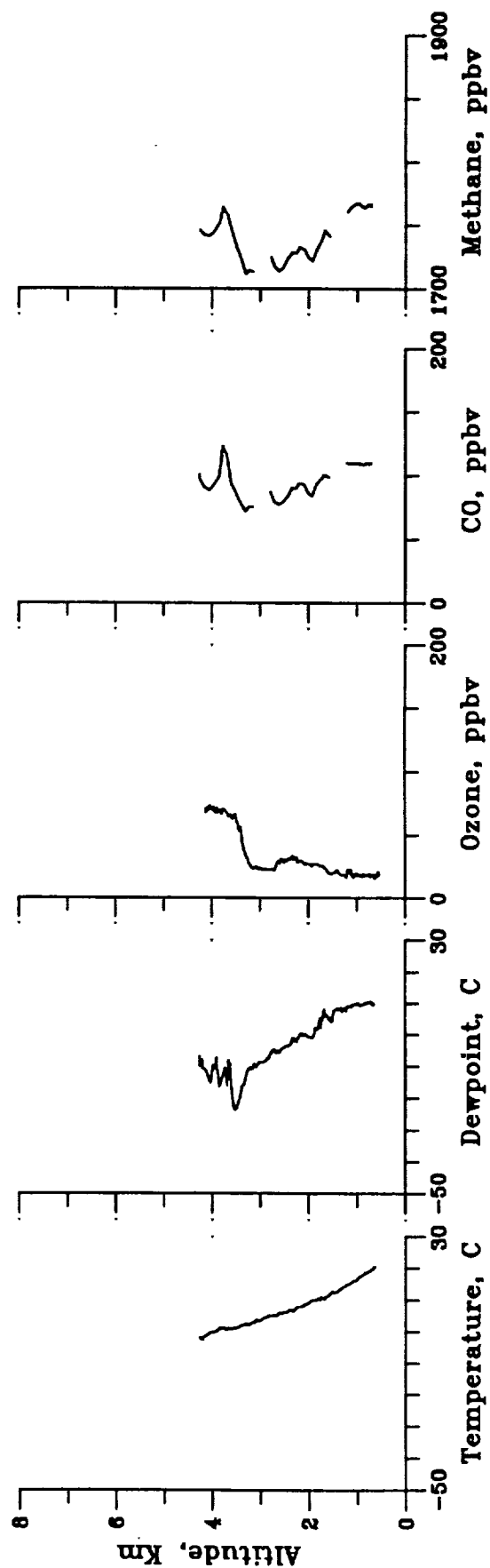


Figure B15.5

ABLE-3B CANADIAN MISSION: FLIGHT 16.

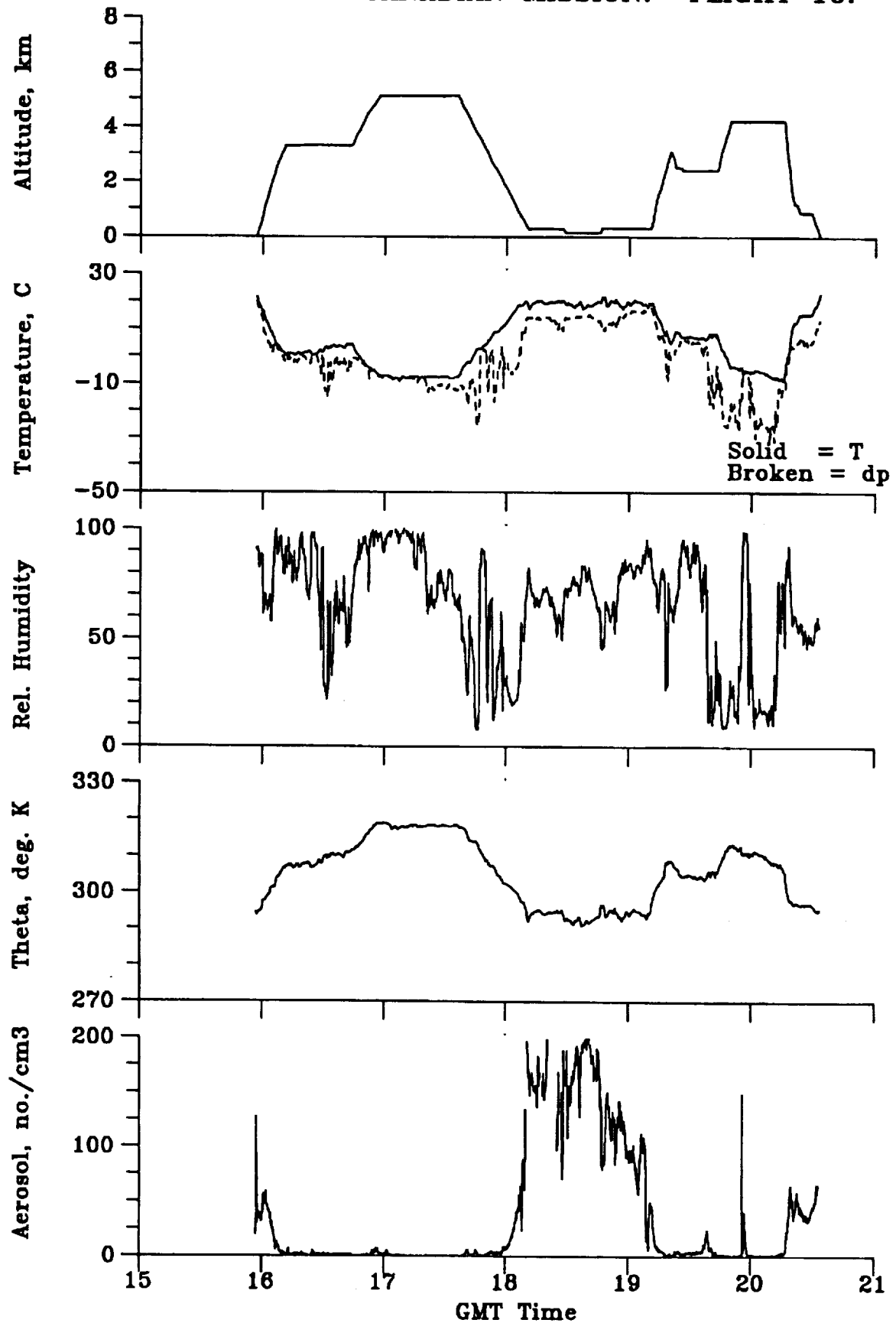


Figure B16.1

# ABLE-3B CANADIAN MISSION: FLIGHT 16.

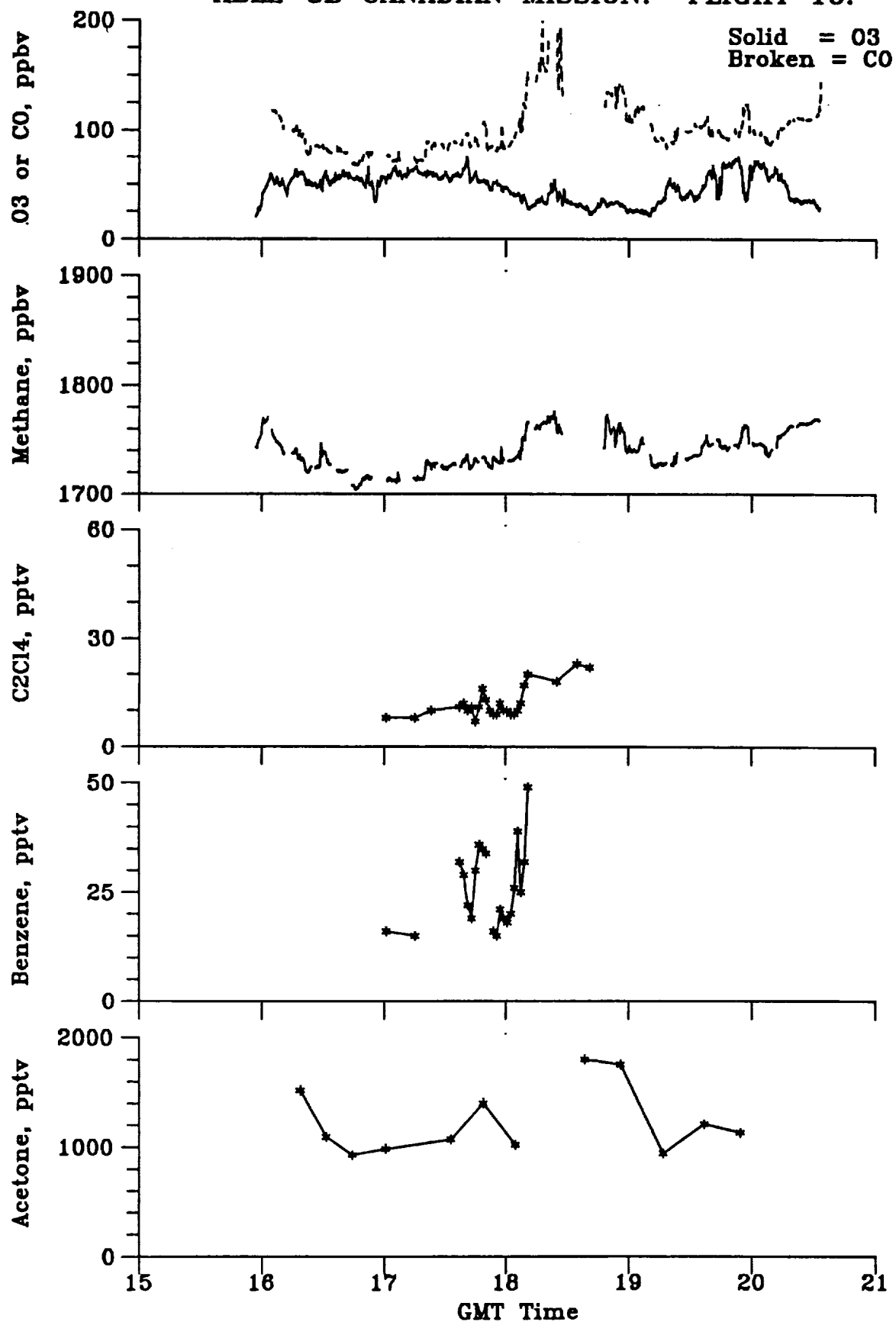


Figure B16.2

# ABLE-3B CANADIAN MISSION: FLIGHT 16.

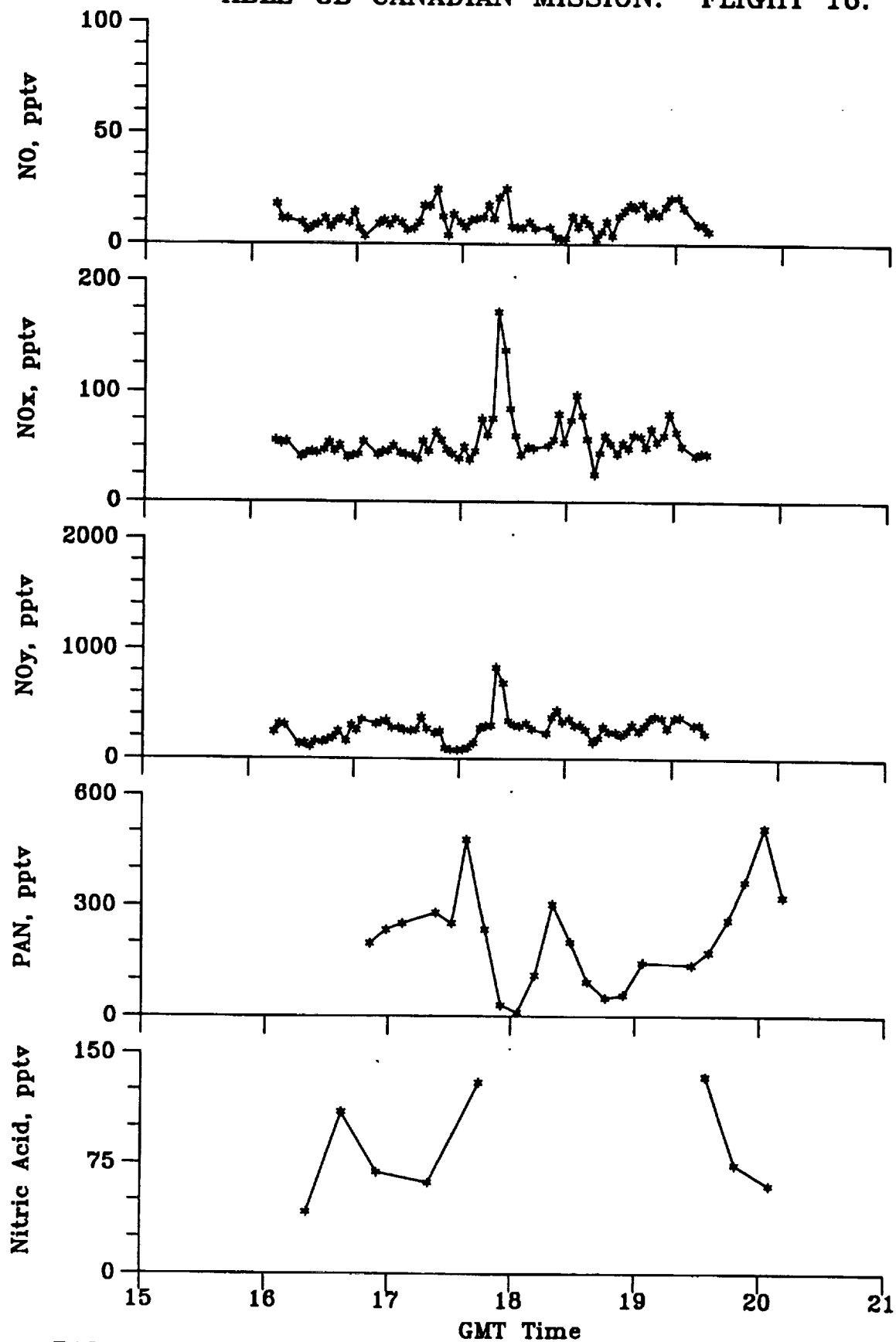


Figure B16.3

ABLE-3B CANADIAN MISSION: FLIGHT 16.

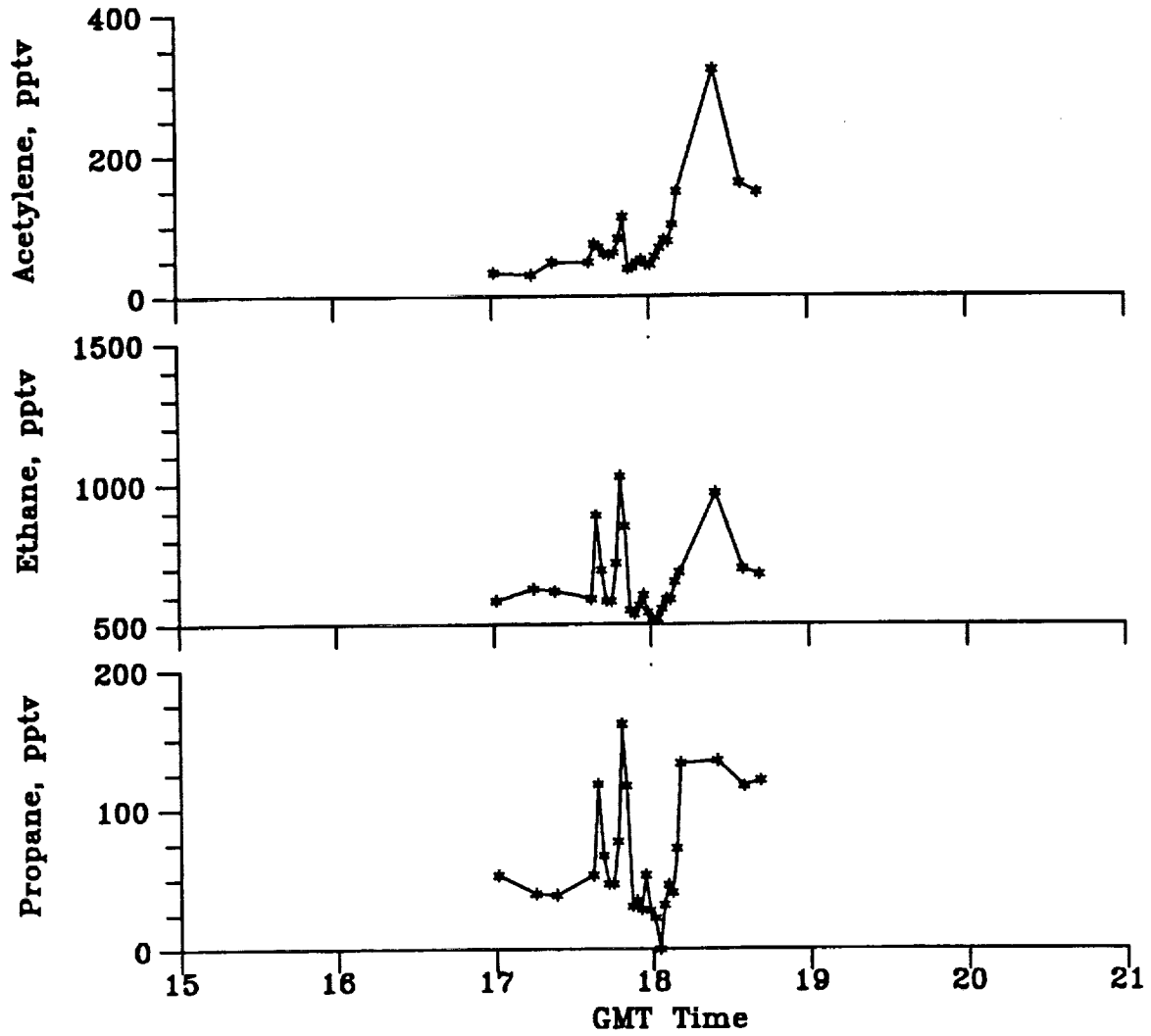
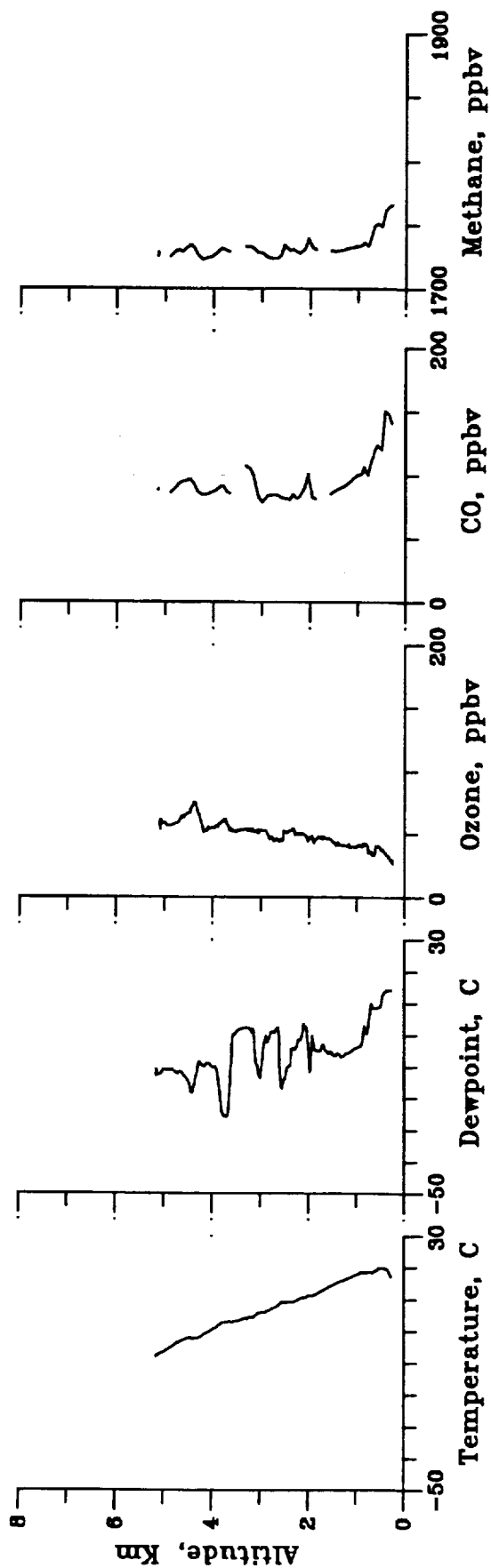


Figure B16.4



ABLE-3B CANADIAN MISSION: FLIGHT 16 PROFILE AT 1800 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 16 PROFILE AT 2015 GMT

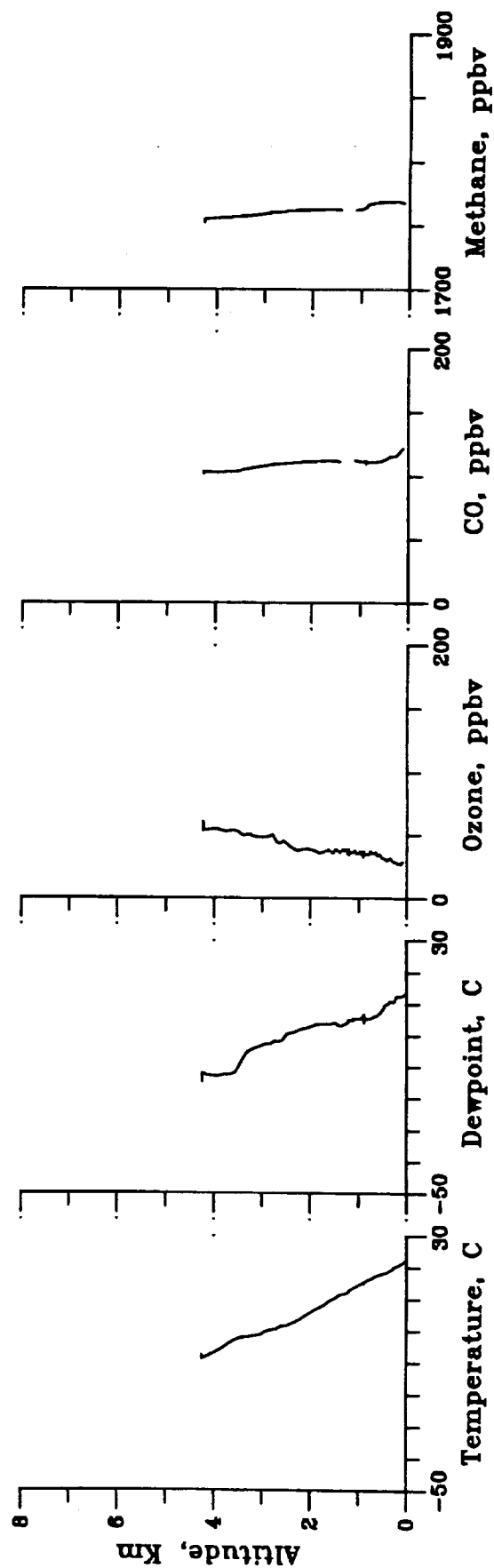


Figure B16.5

ABLE-3B CANADIAN MISSION: FLIGHT 17.

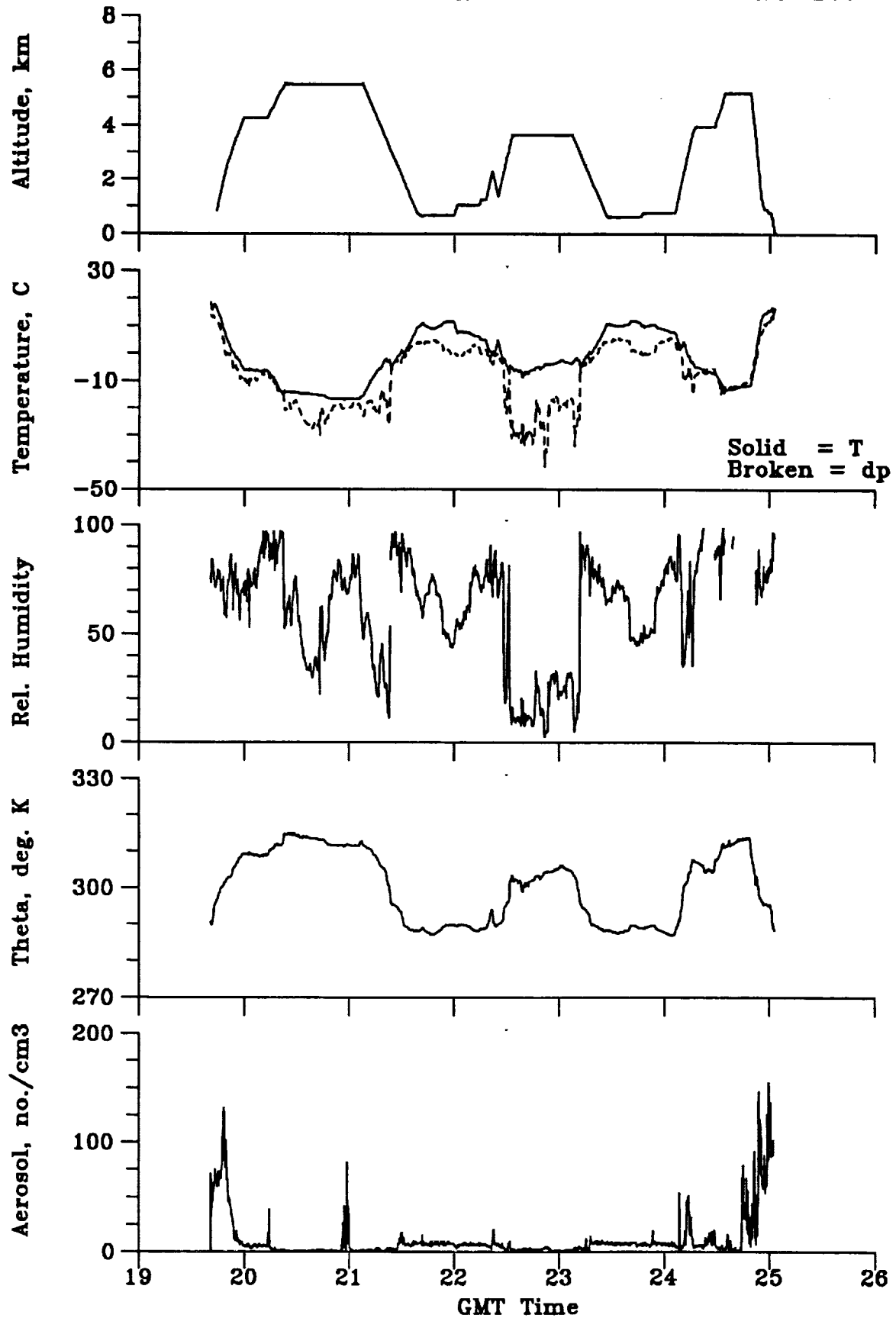


Figure B17.1

# ABLE-3B CANADIAN MISSION: FLIGHT 17.

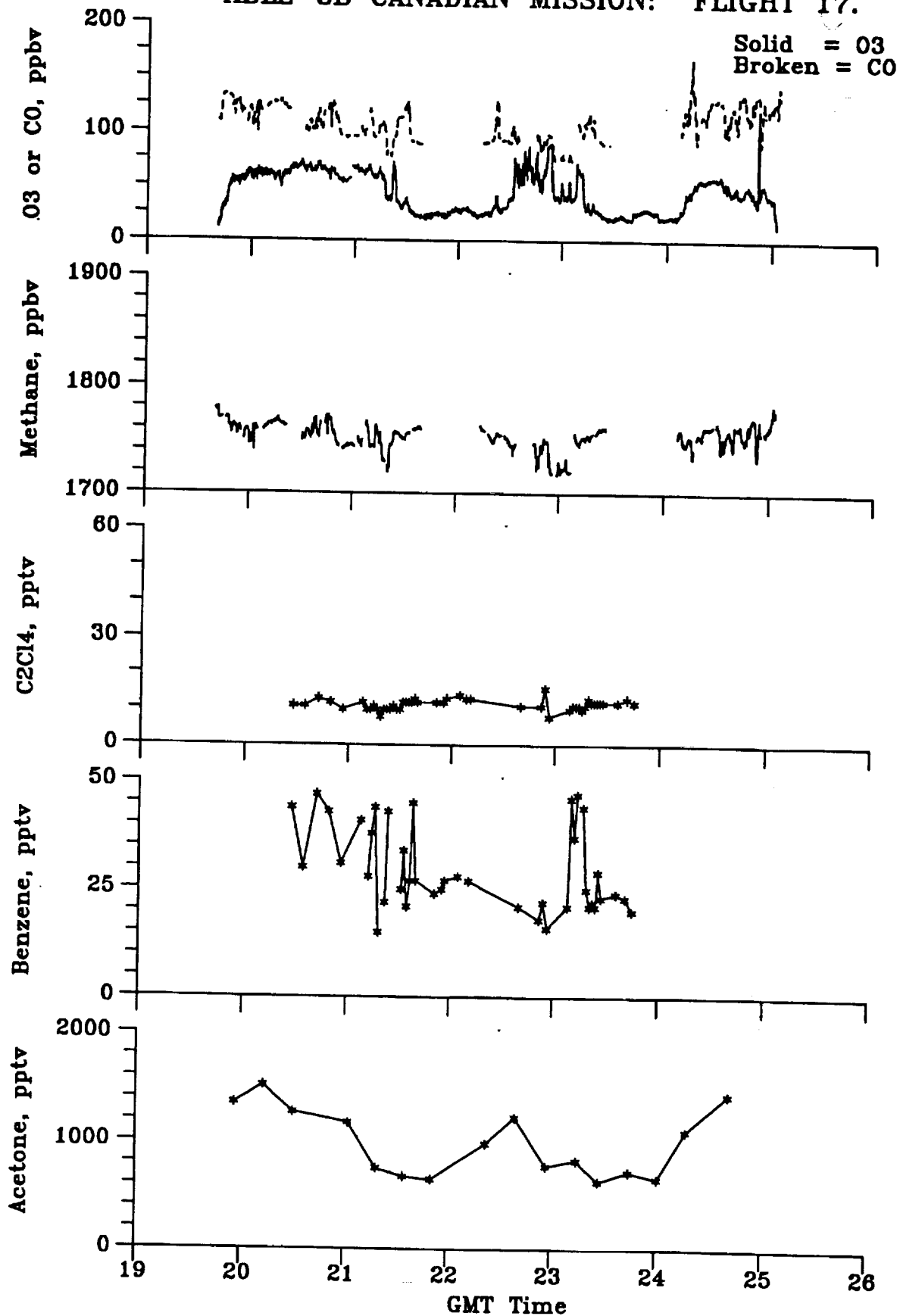


Figure B17.2

# ABLE-3B CANADIAN MISSION: FLIGHT 17.

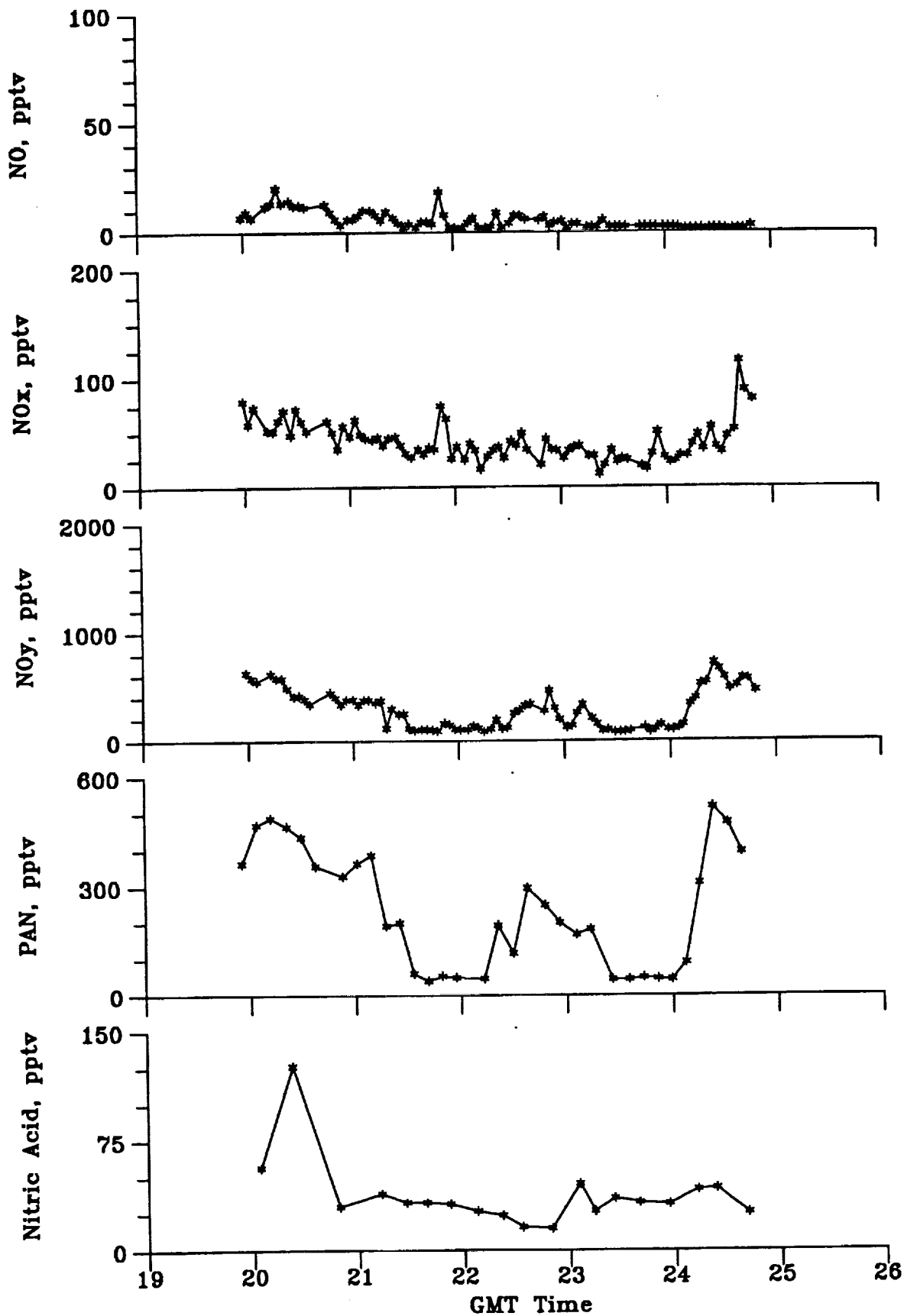


Figure B17.3

ABLE-3B CANADIAN MISSION: FLIGHT 17.

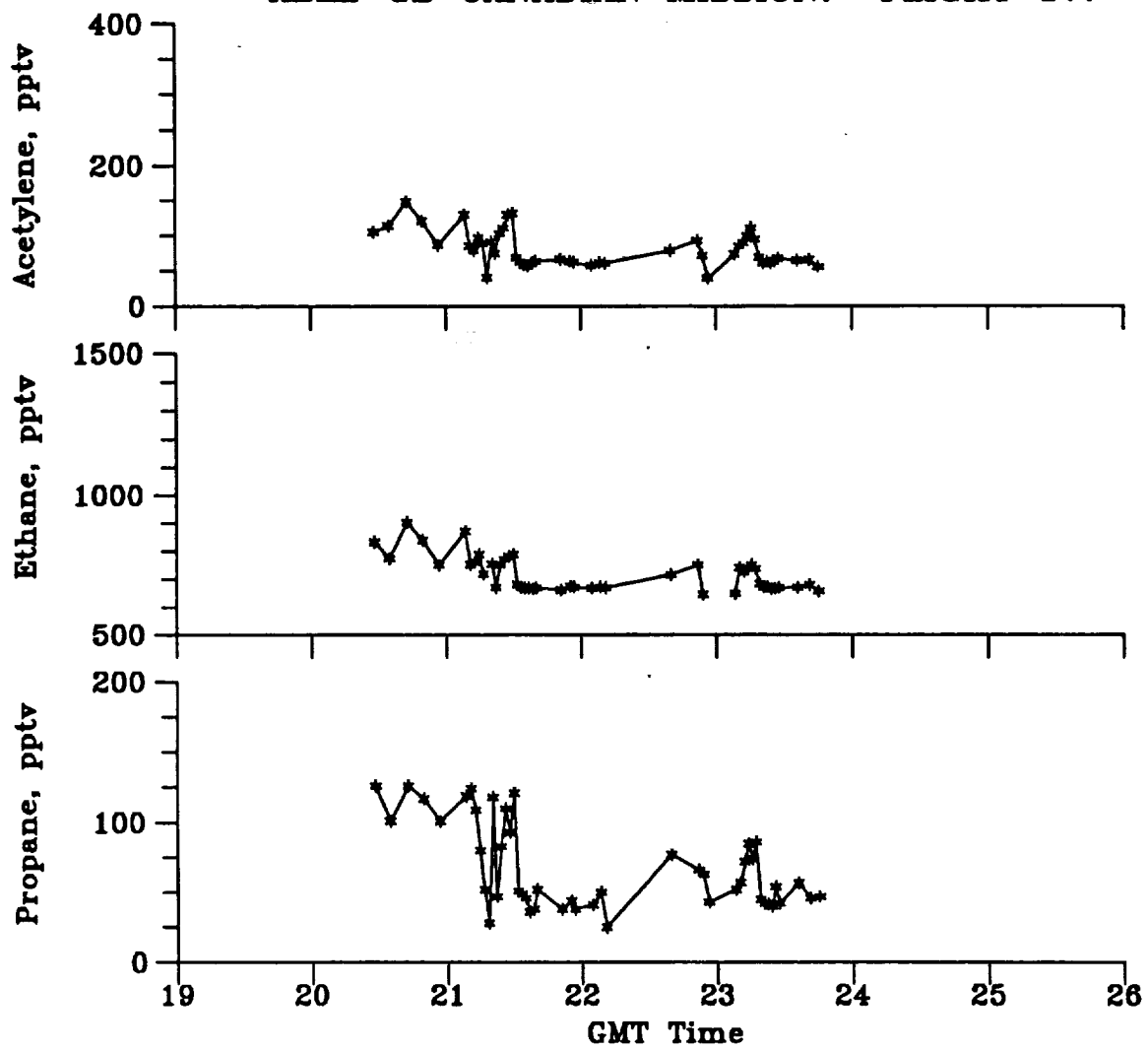
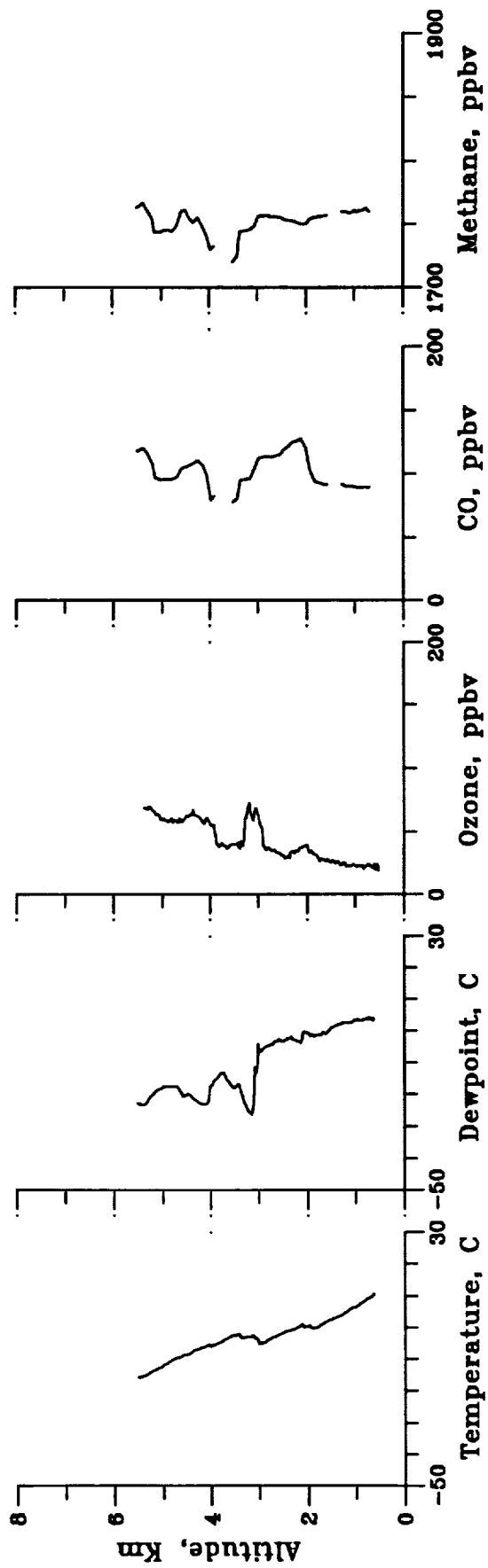


Figure B17.4

ABLE-3B CANADIAN MISSION: FLIGHT 17 PROFILE AT 2130 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 17 PROFILE AT 0015 GMT

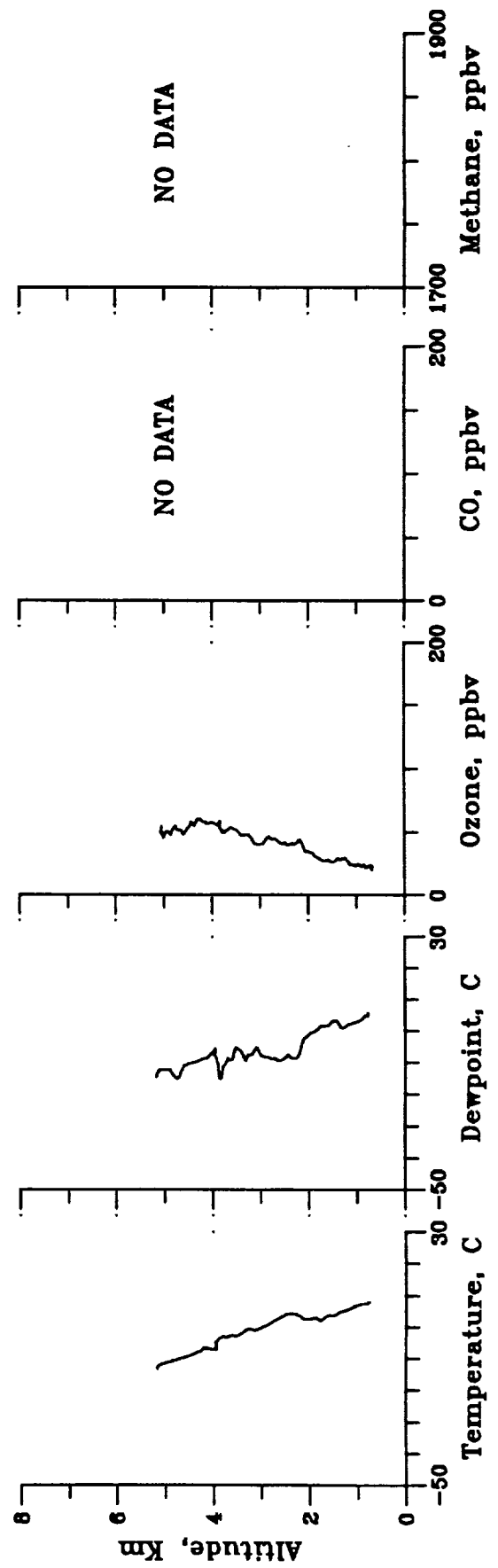


Figure B17.5

# ABLE-3B CANADIAN MISSION: FLIGHT 18.

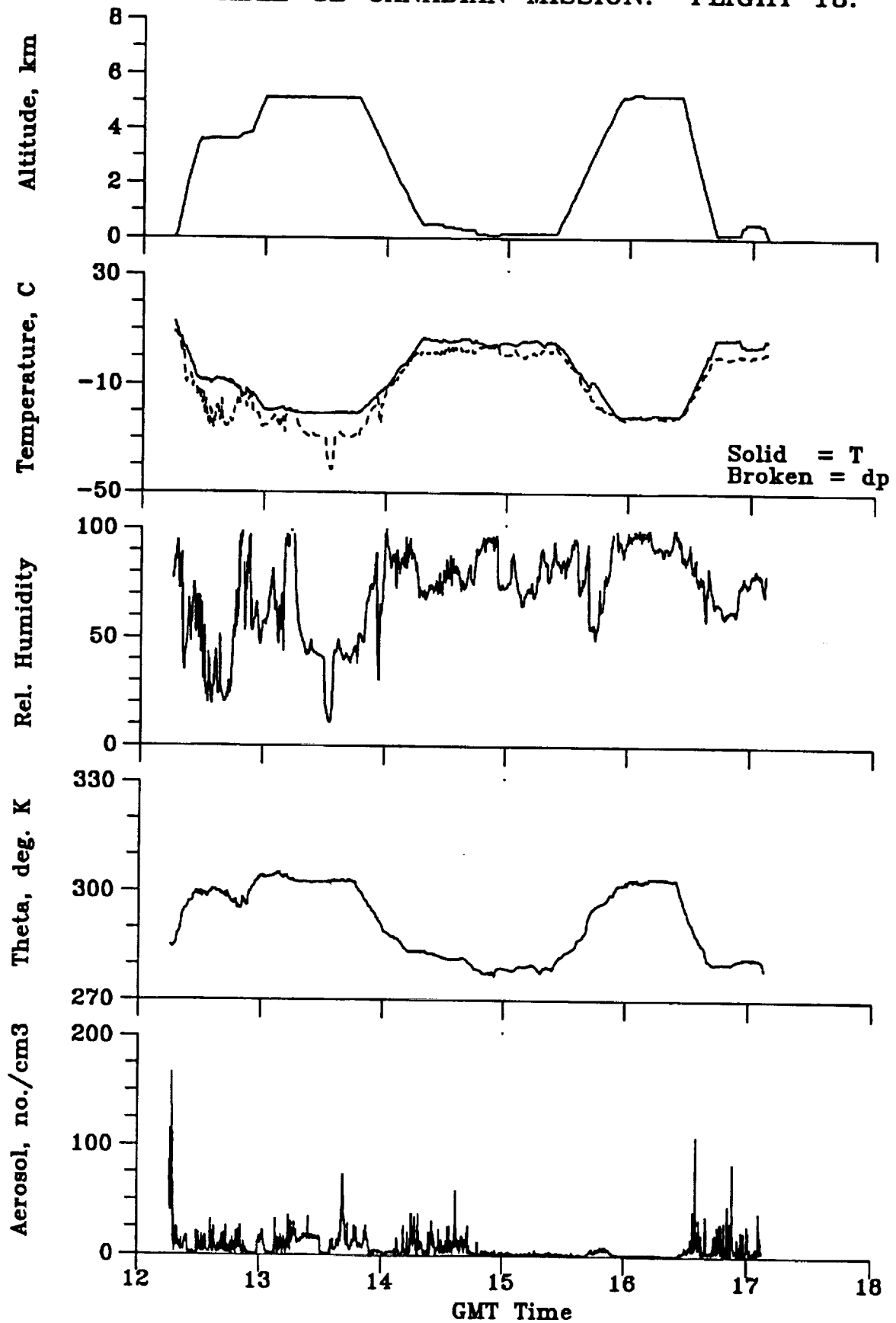


Figure B18.1

# ABLE-3B CANADIAN MISSION: FLIGHT 18.

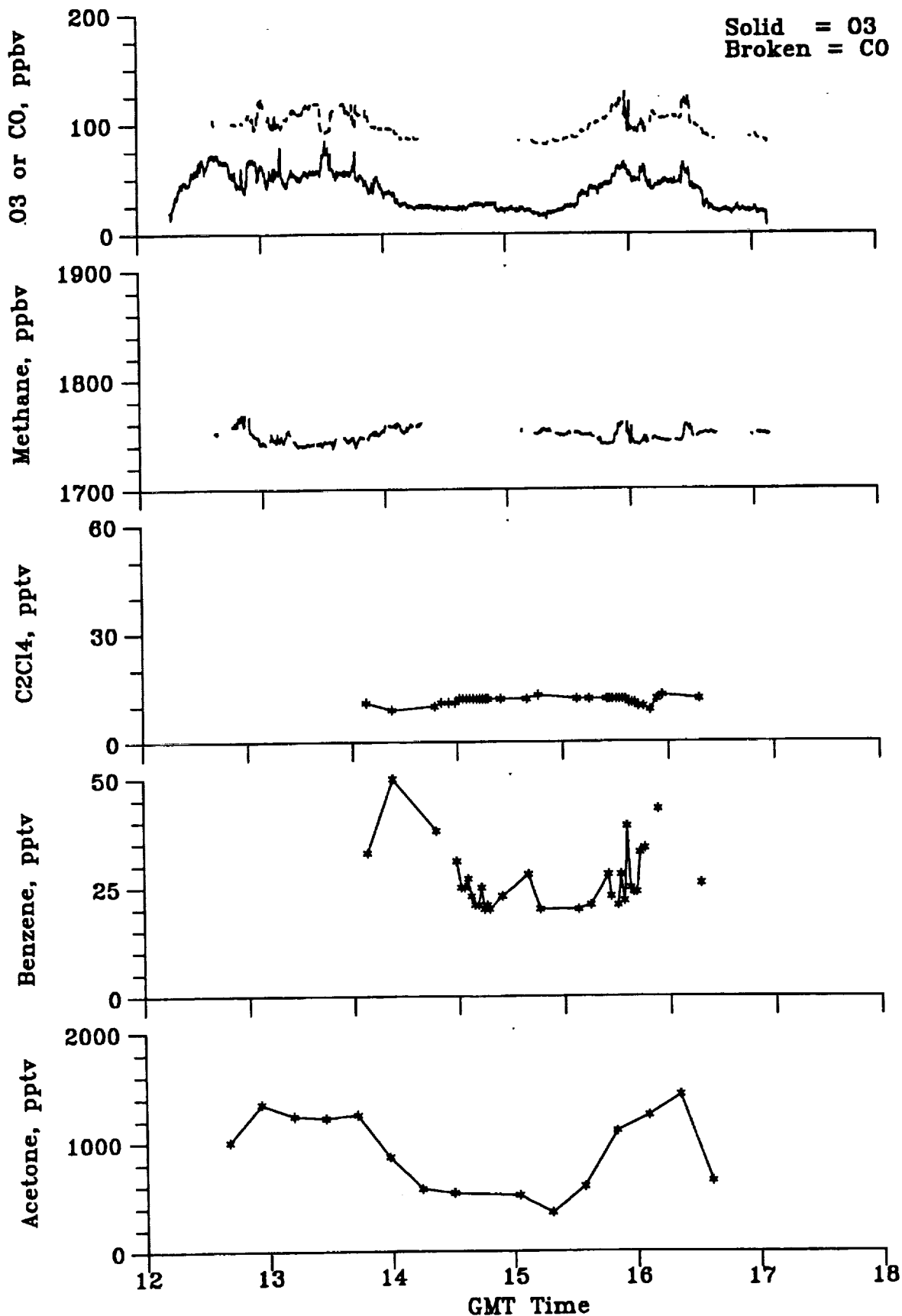


Figure B18.2



# ABLE-3B CANADIAN MISSION: FLIGHT 18.

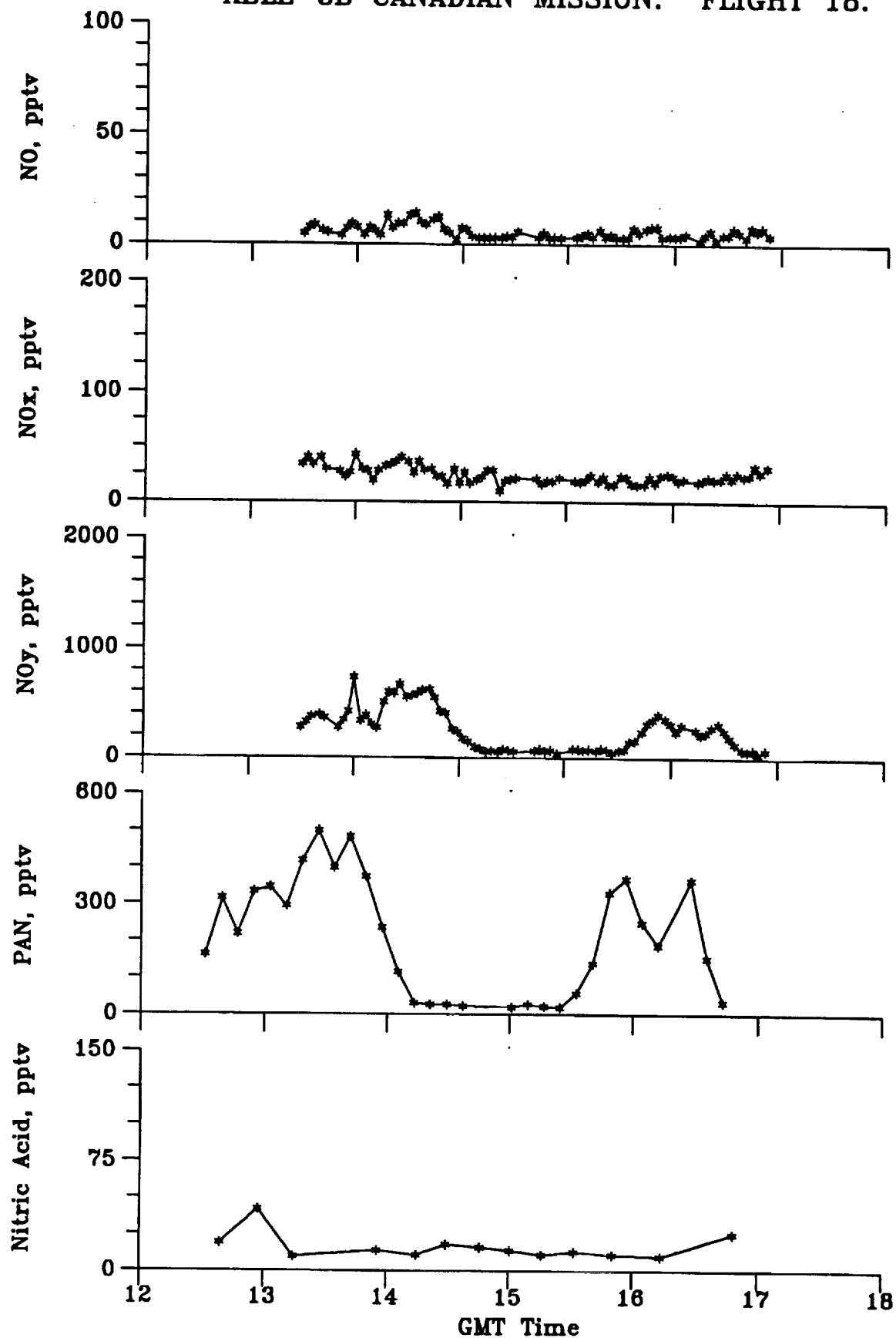


Figure B18.3

ABLE-3B CANADIAN MISSION: FLIGHT 18.

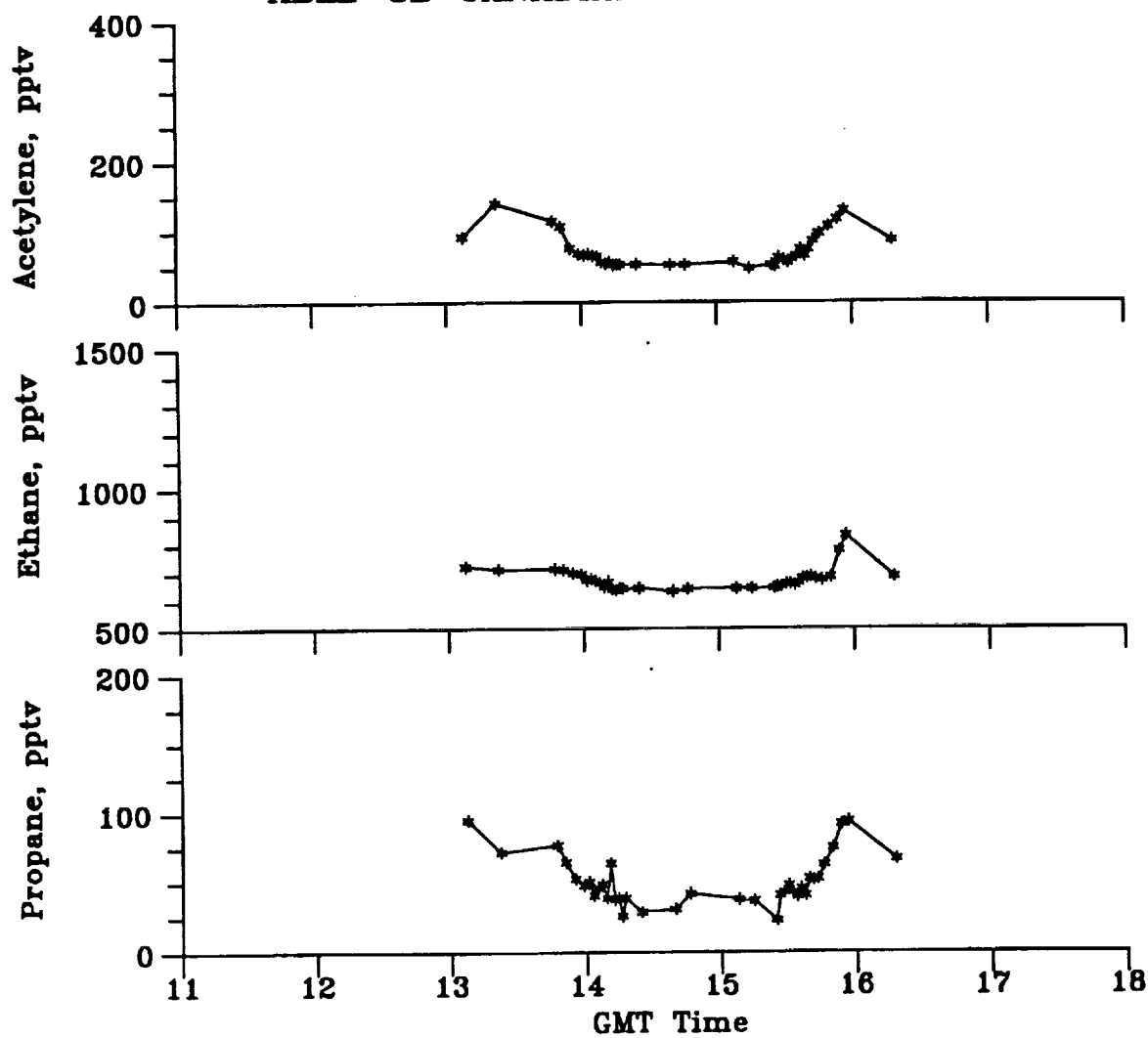
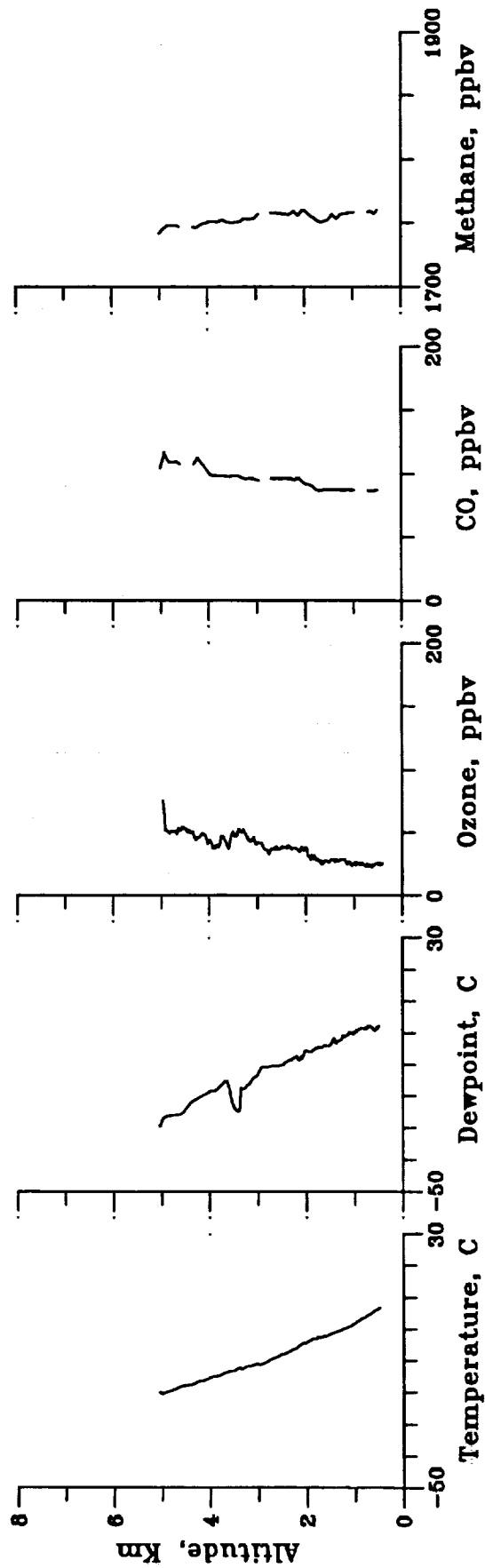


Figure B18.4

ABLE-3B CANADIAN MISSION: FLIGHT 18 PROFILE AT 1400 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 18 PROFILE AT 1545 GMT

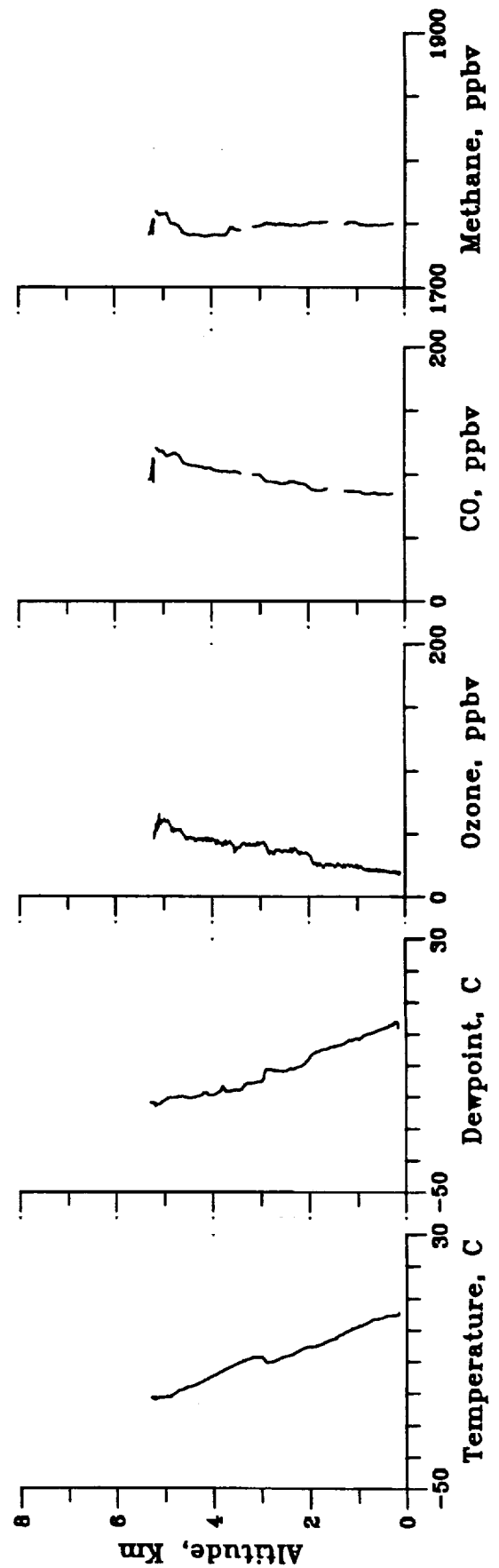


Figure B18.5

# ABLE-3B CANADIAN MISSION: FLIGHT 19.

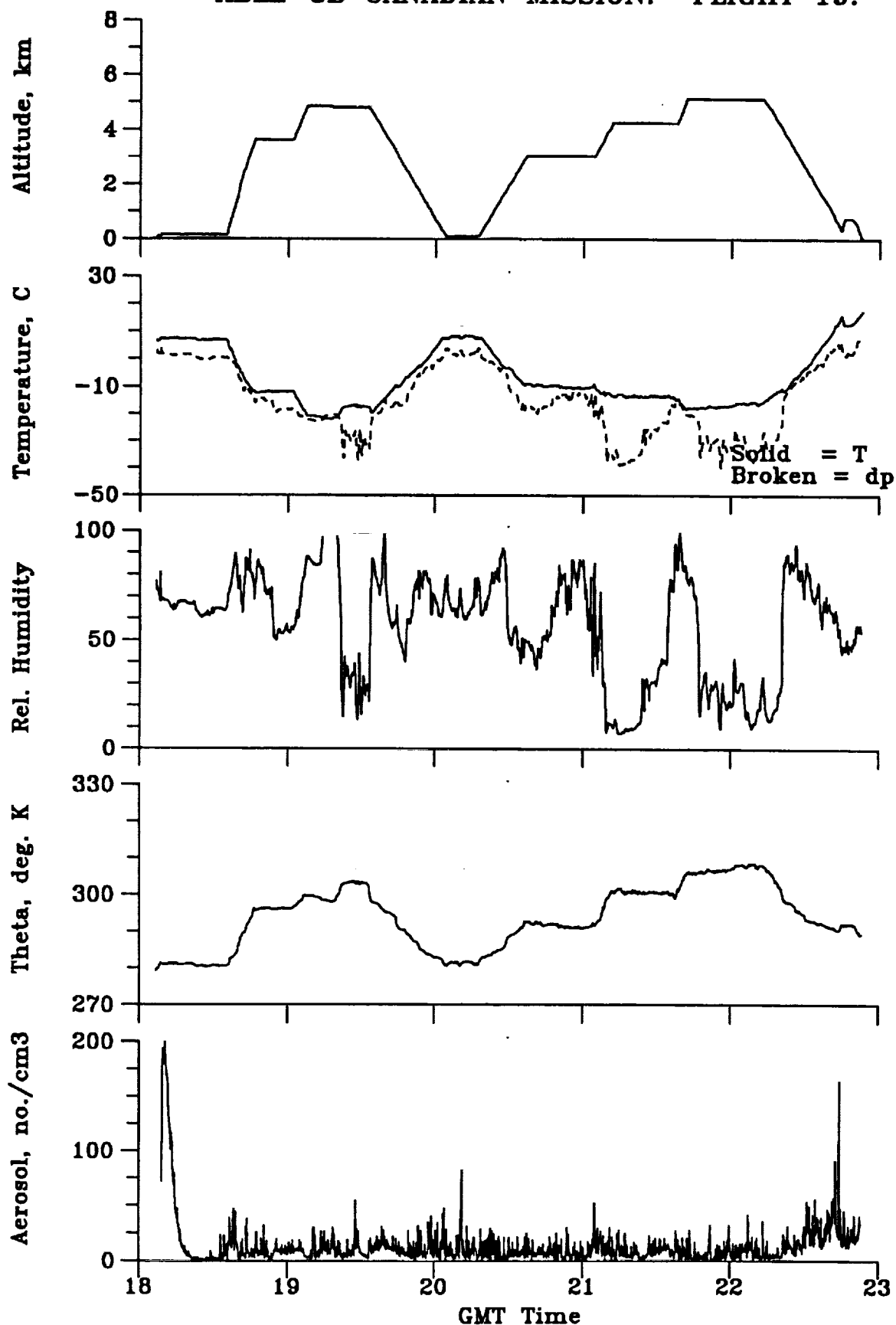


Figure B19.1

# ABLE-3B CANADIAN MISSION: FLIGHT 19.

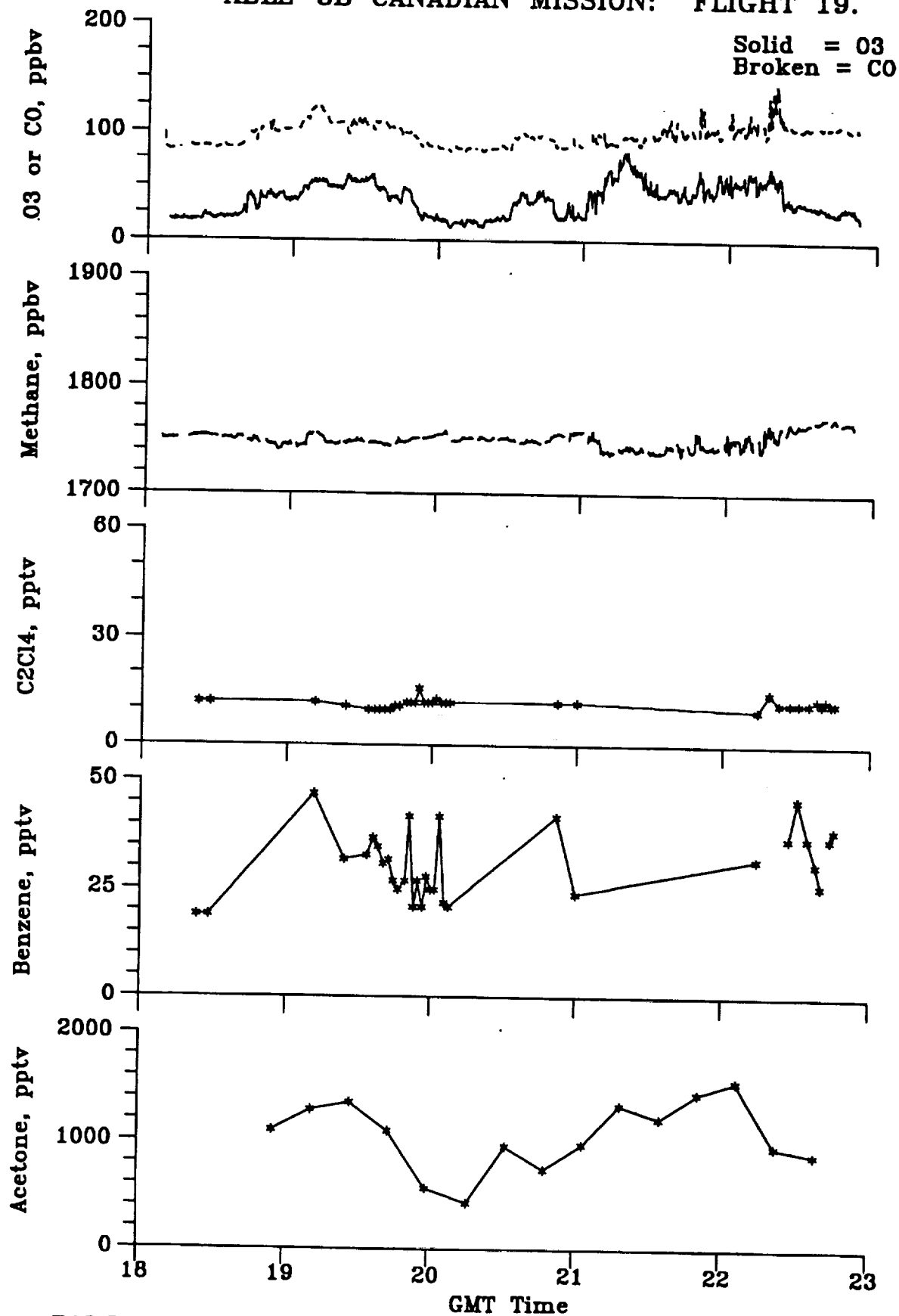


Figure B19.2

# ABLE-3B CANADIAN MISSION: FLIGHT 19.

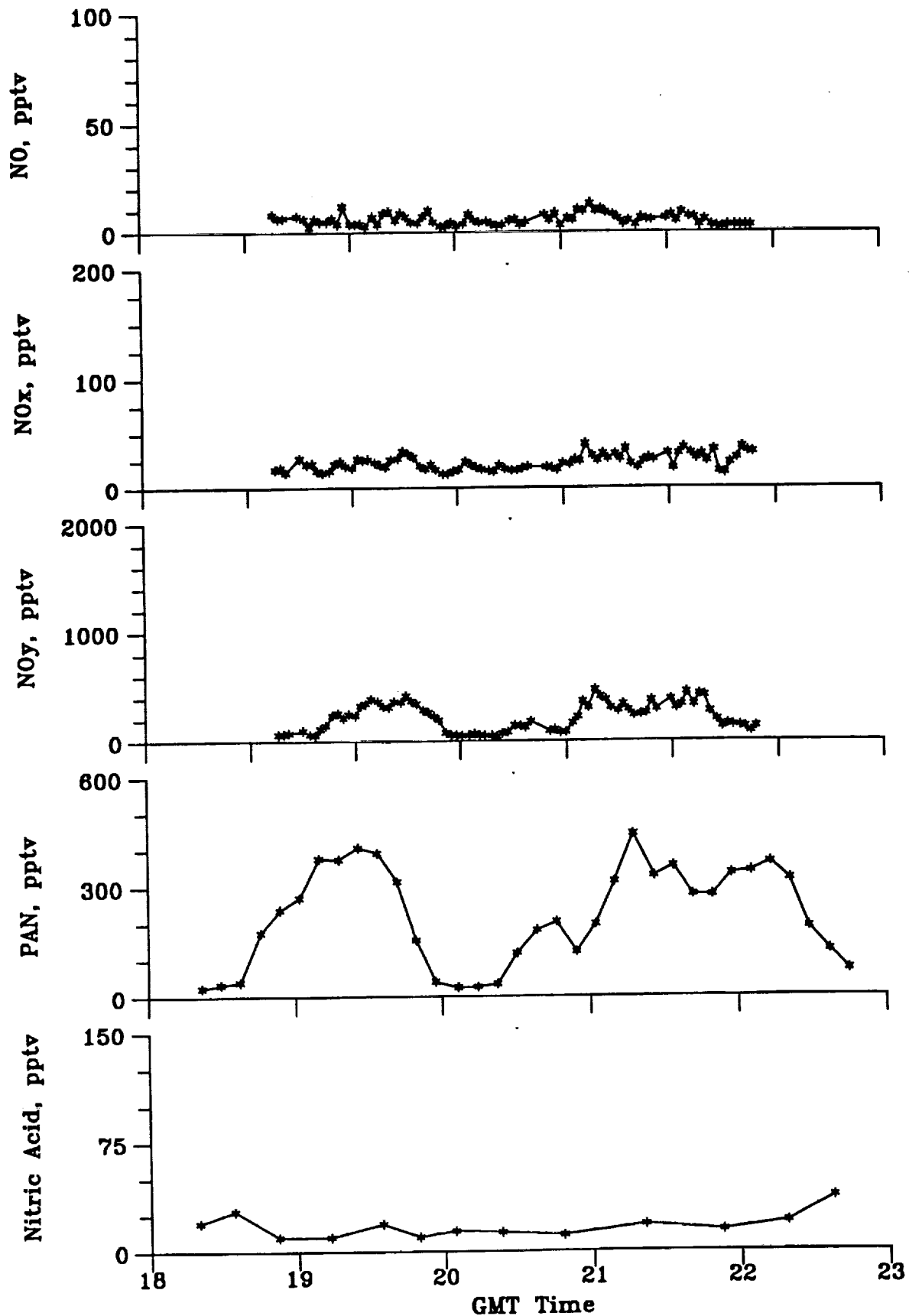


Figure B19.3

ABLE-3B CANADIAN MISSION: FLIGHT 19.

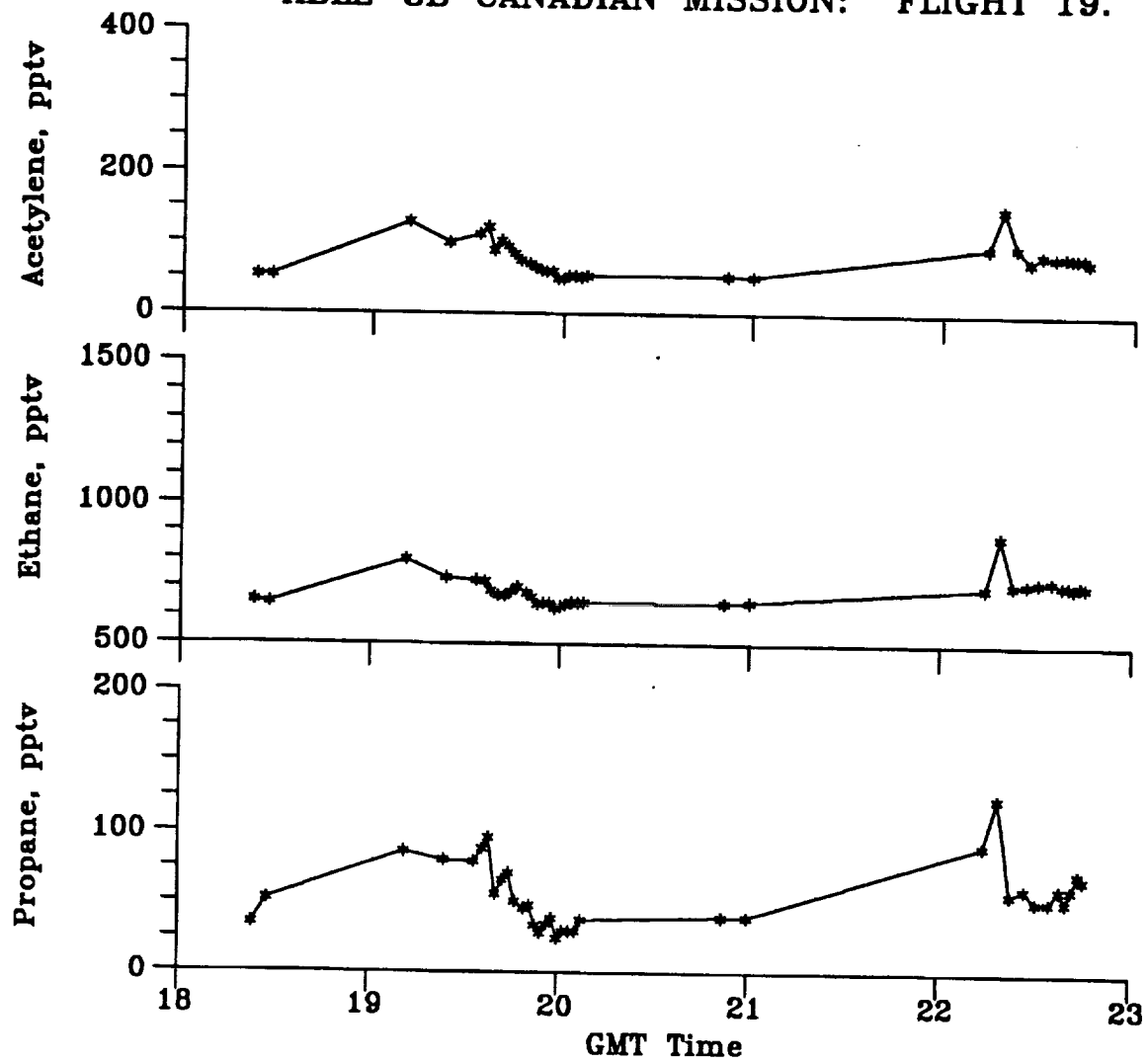
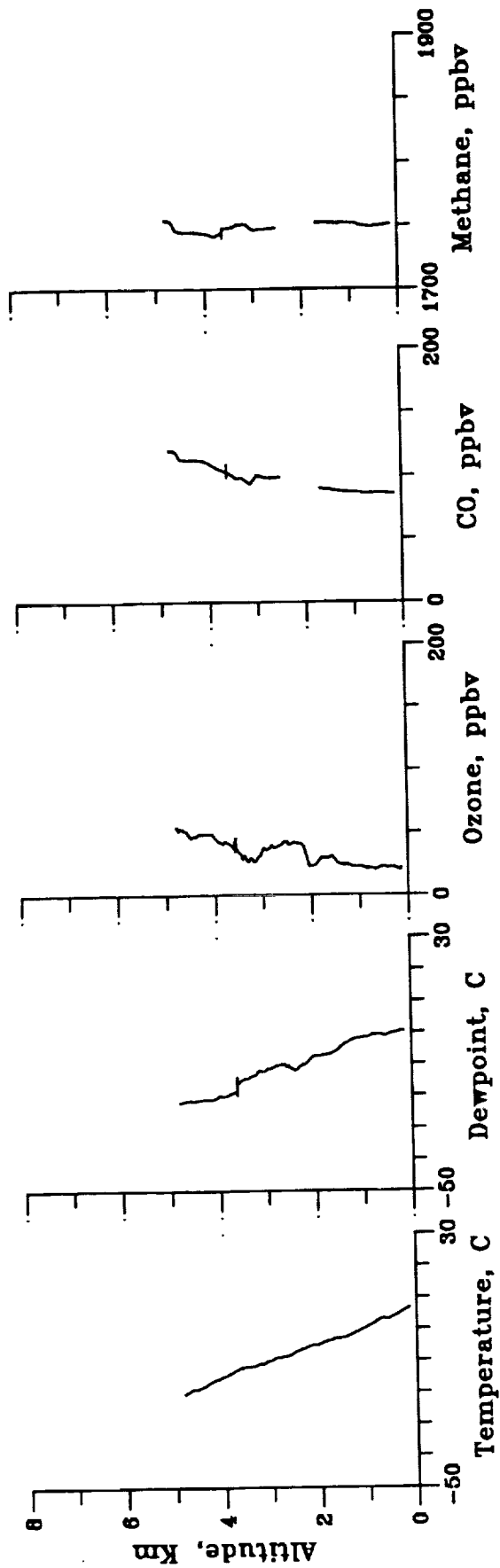


Figure B19.4

ABLE-3B CANADIAN MISSION: FLIGHT 19 PROFILE AT 1900 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 19 PROFILE AT 1945 GMT

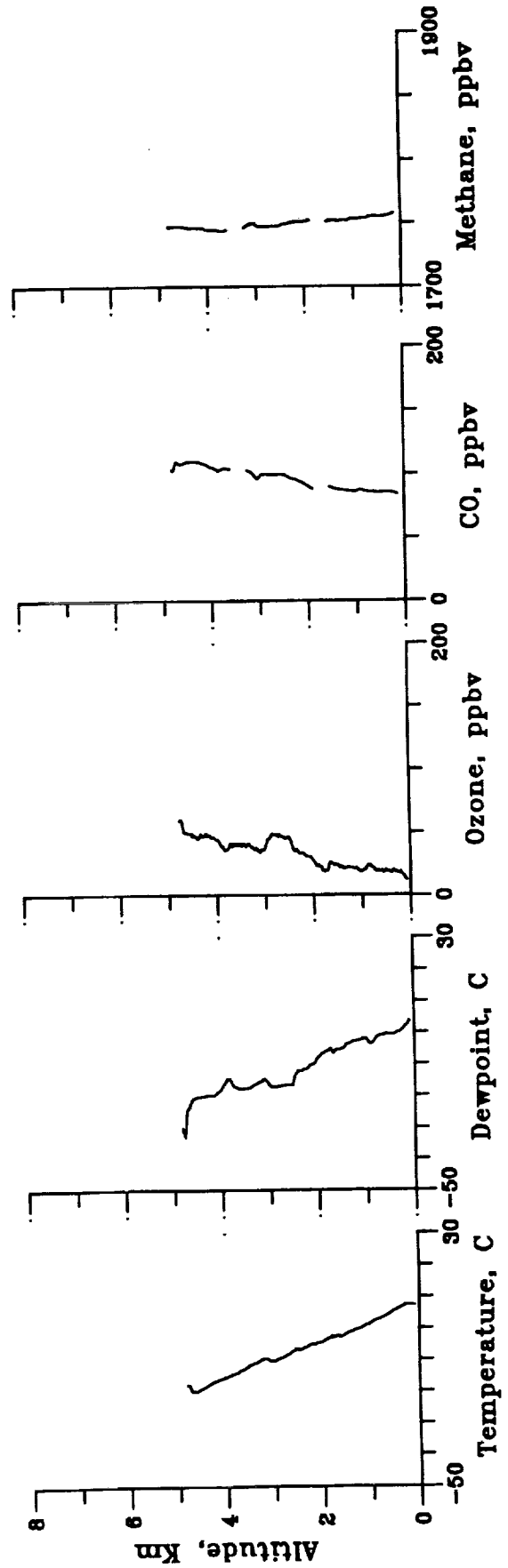


Figure B19.5



ABLE-3B CANADIAN MISSION: FLIGHT 19 PROFILE AT 2230 GMT

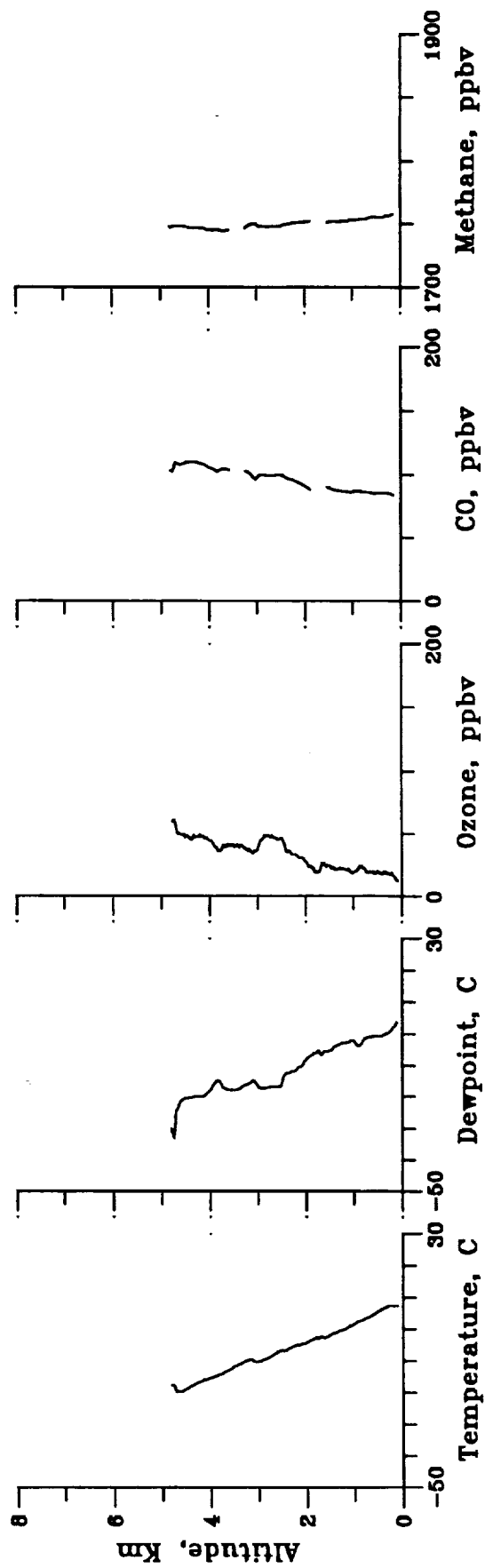


Figure B19.6

# ABLE-3B CANADIAN MISSION: FLIGHT 20.

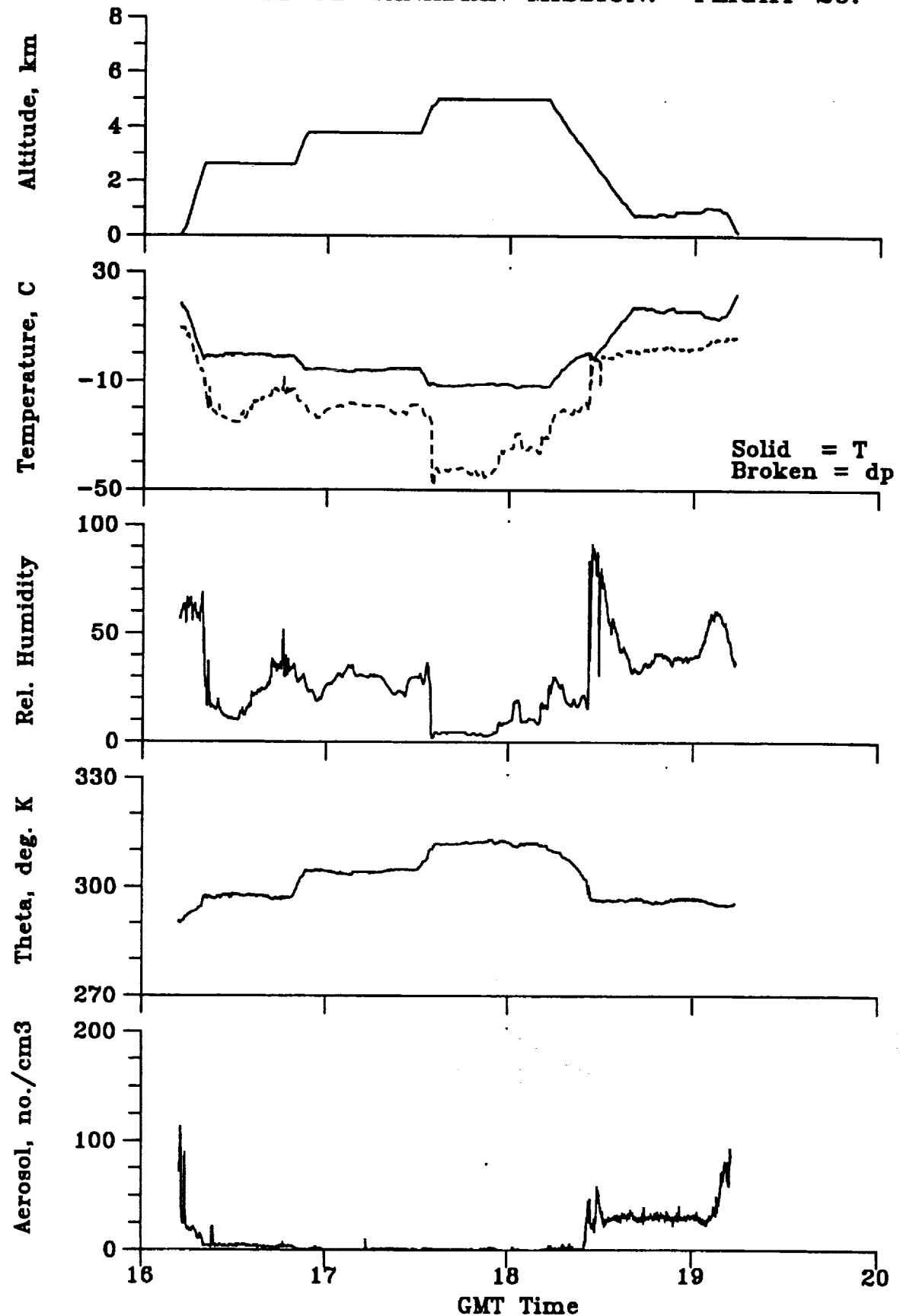


Figure B20.1

# ABLE-3B CANADIAN MISSION: FLIGHT 20.

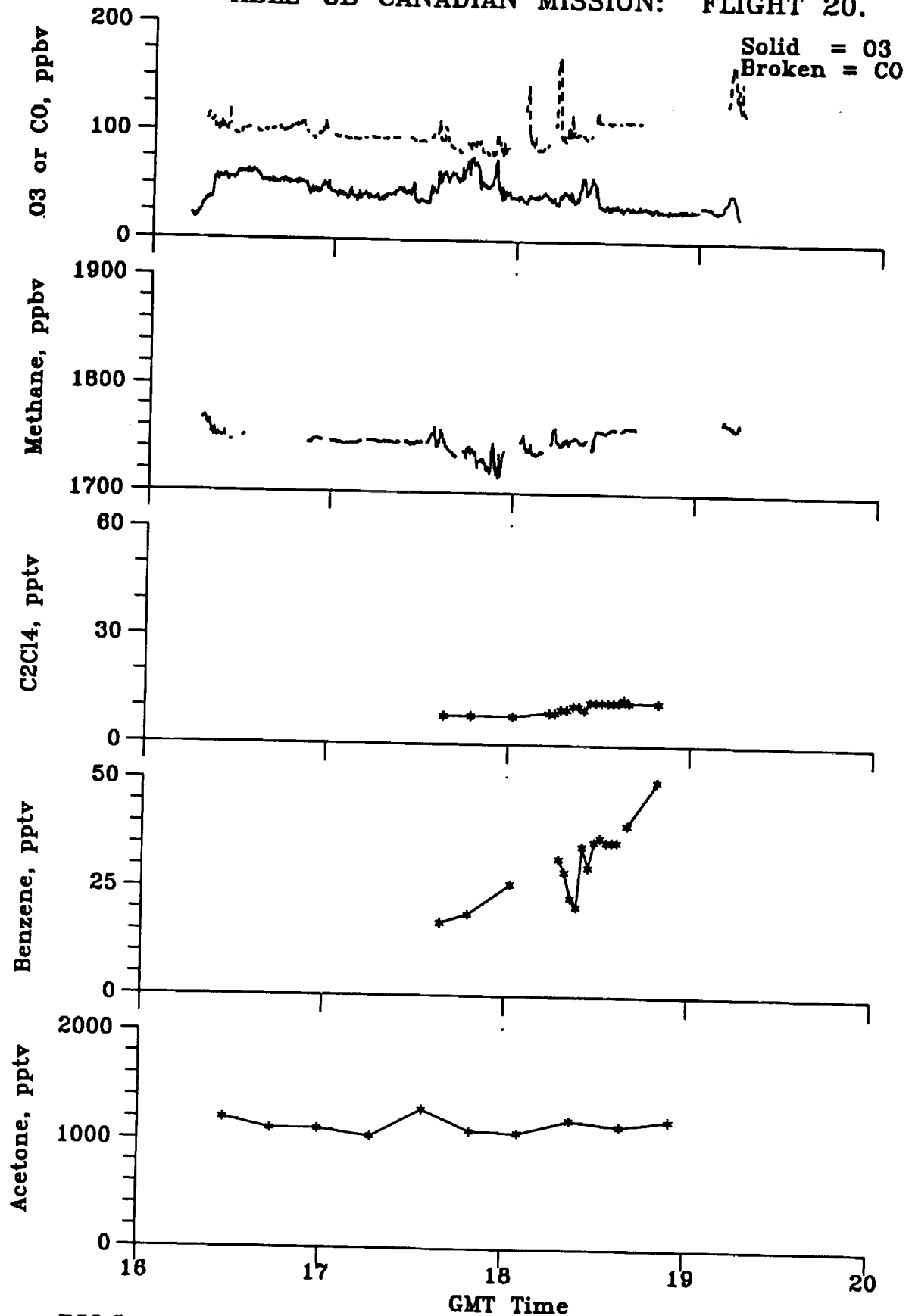


Figure B20.2

# ABLE-3B CANADIAN MISSION: FLIGHT 20.

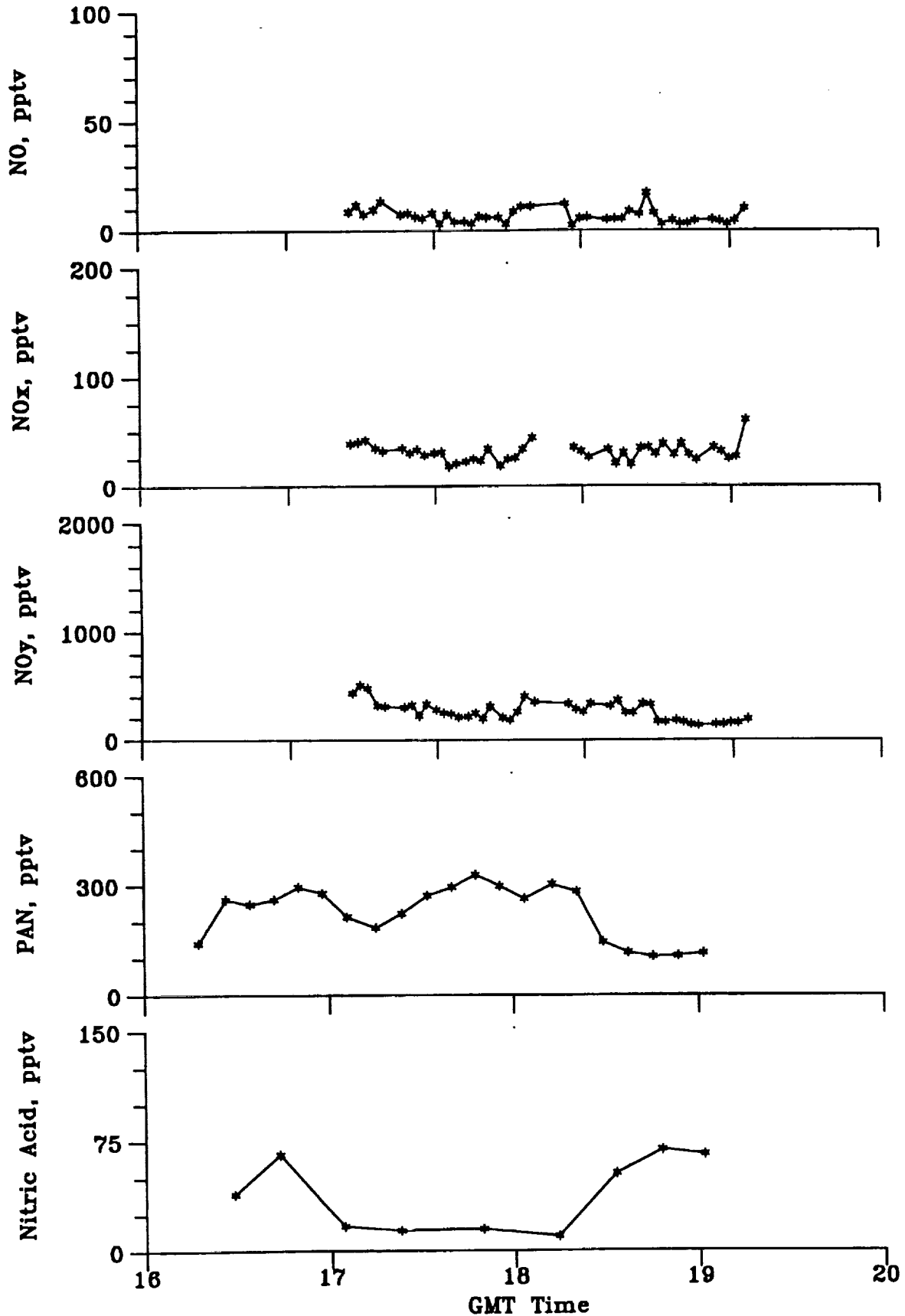


Figure B20.3

ABLE-3B CANADIAN MISSION: FLIGHT 20.

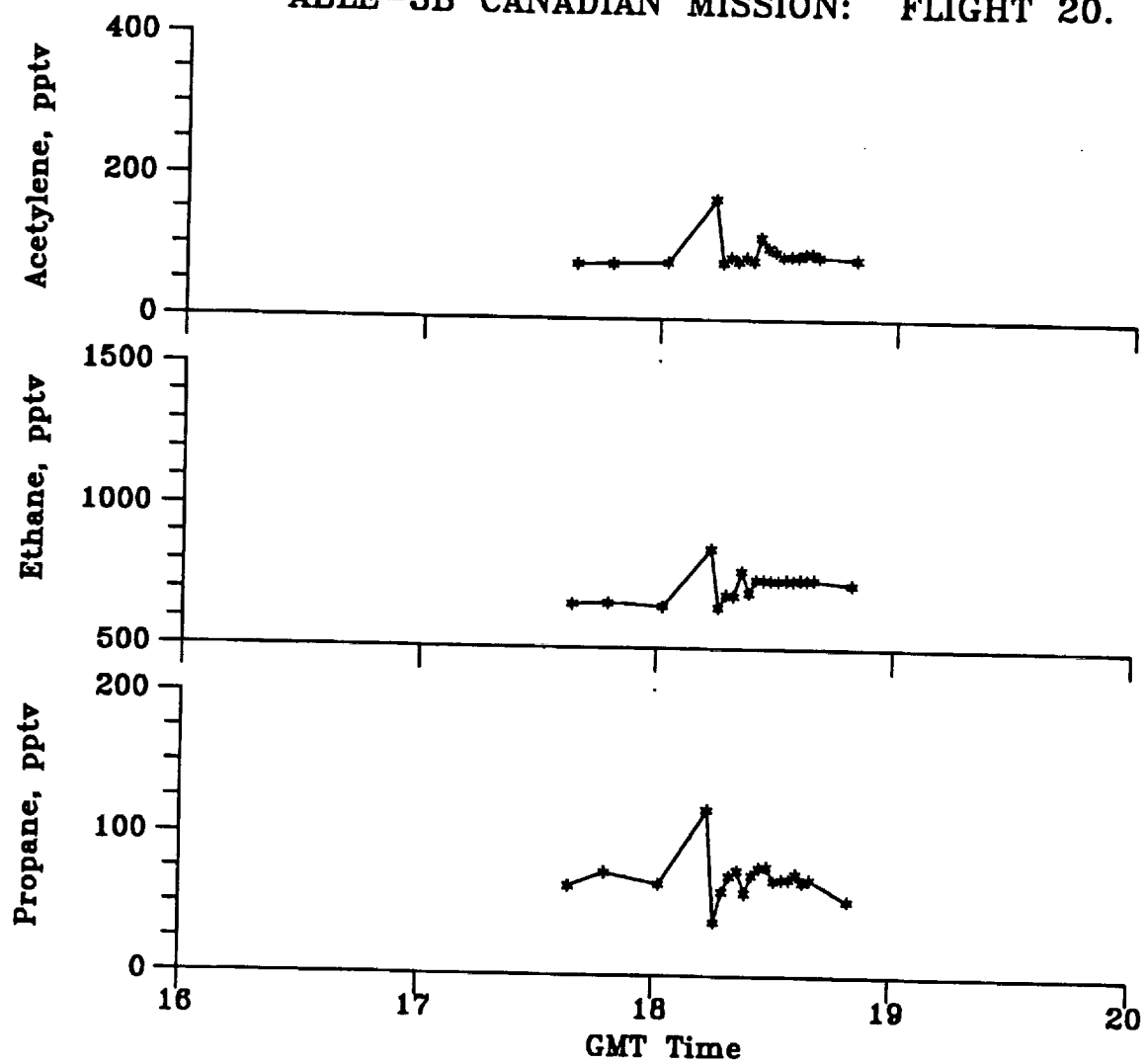


Figure B20.4

ABLE-3B CANADIAN MISSION: FLIGHT 20 PROFILE AT 1830 GMT

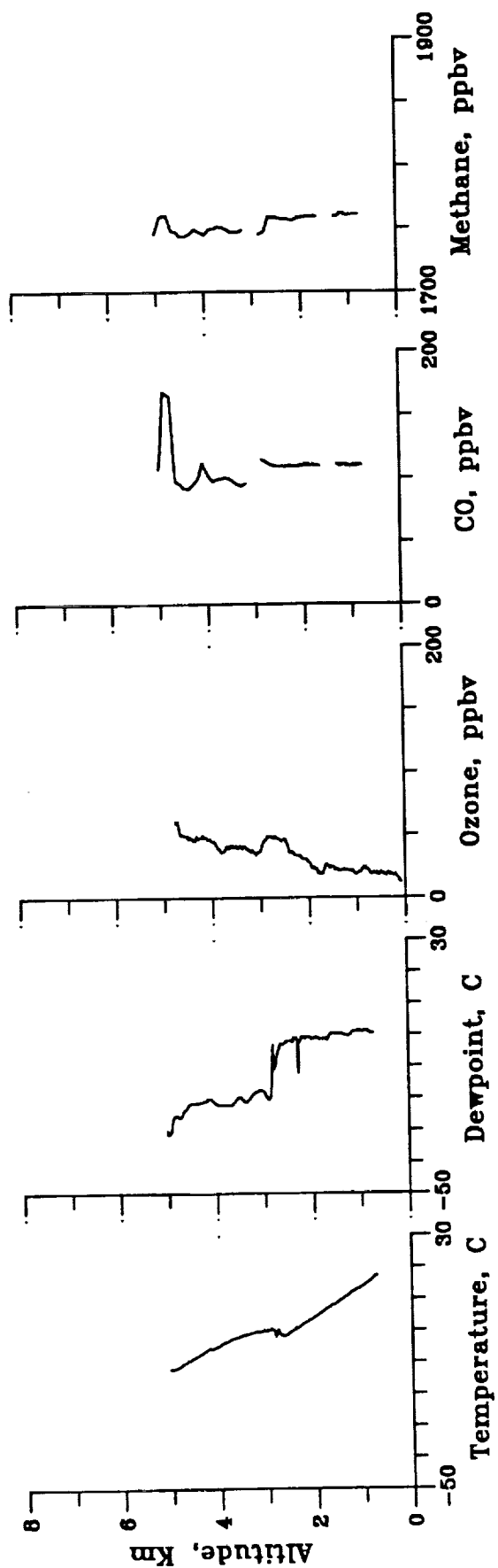


Figure B20.5

# ABLE-3B CANADIAN MISSION: FLIGHT 21.

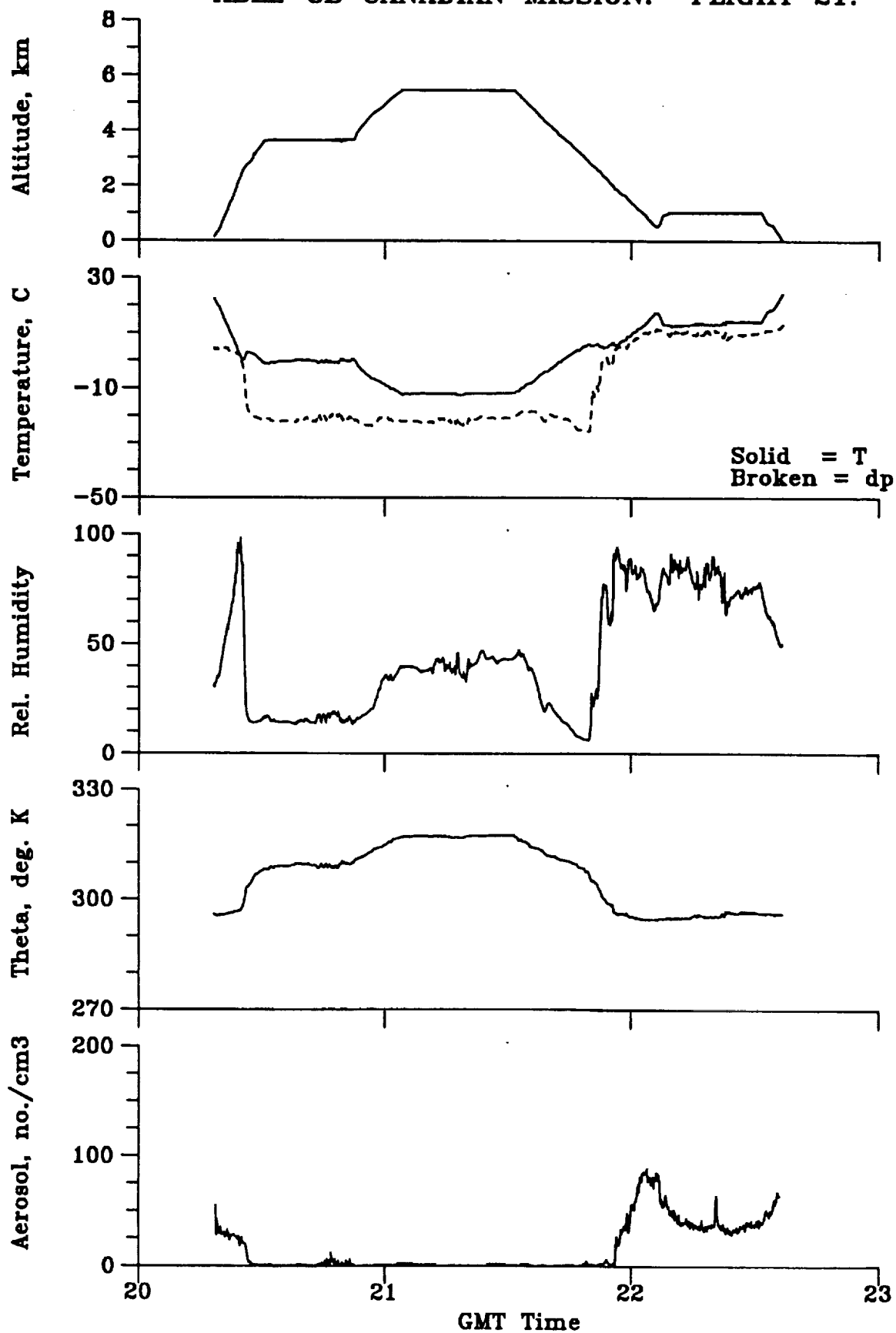


Figure B21.1

# ABLE-3B CANADIAN MISSION: FLIGHT 21.

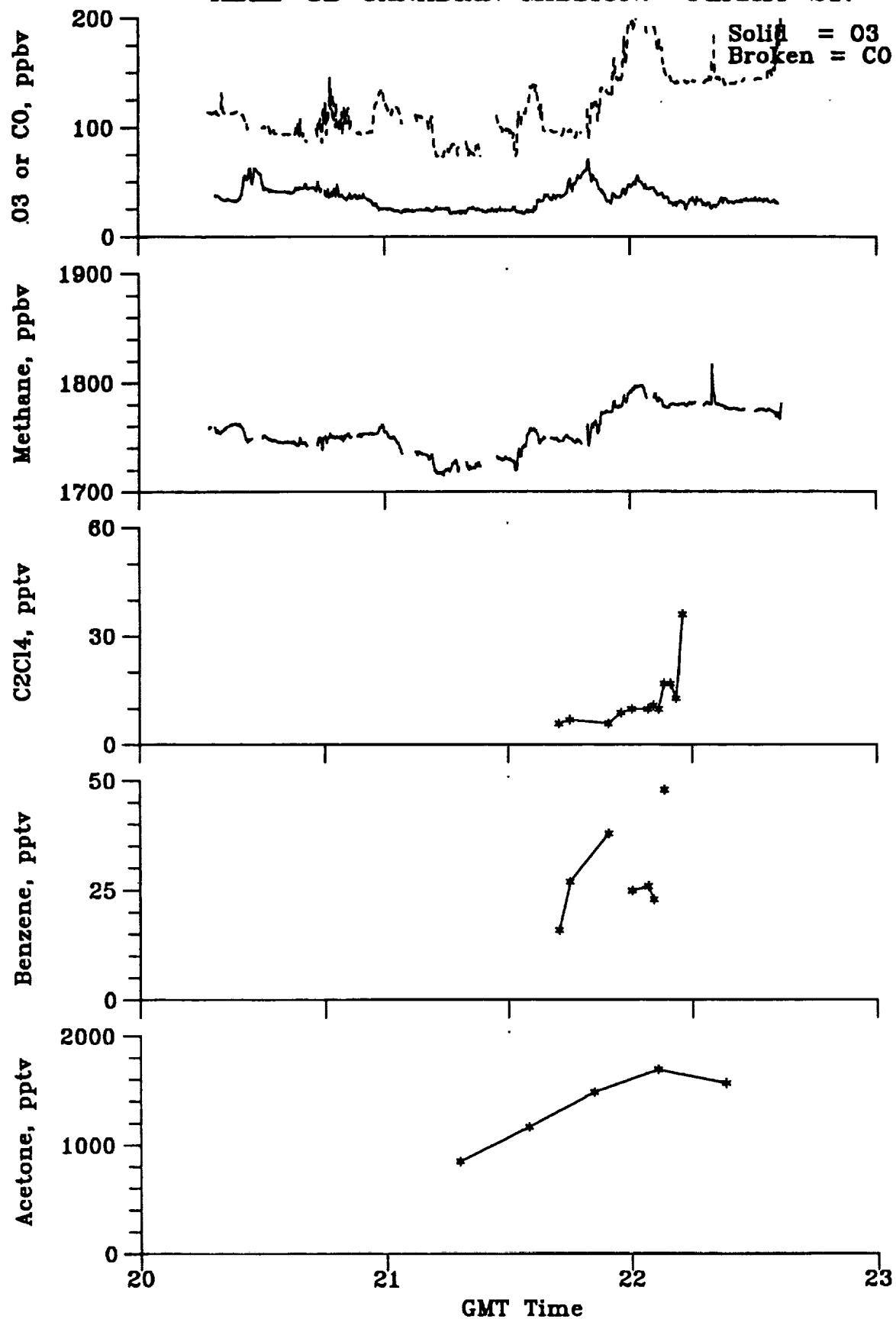


Figure B21.2



# ABLE-3B CANADIAN MISSION: FLIGHT 21.

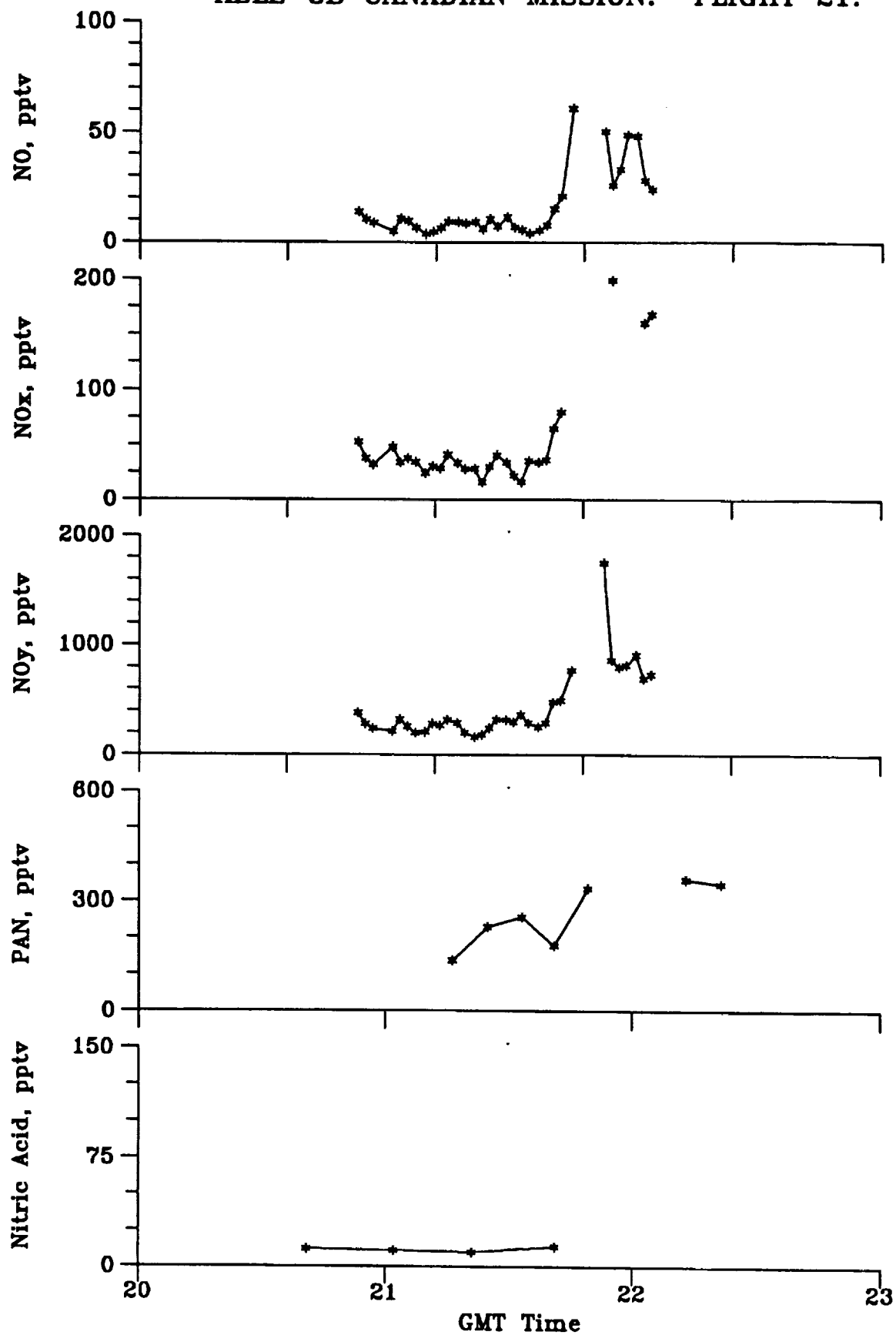


Figure B21.3

ABLE-3B CANADIAN MISSION: FLIGHT 21.

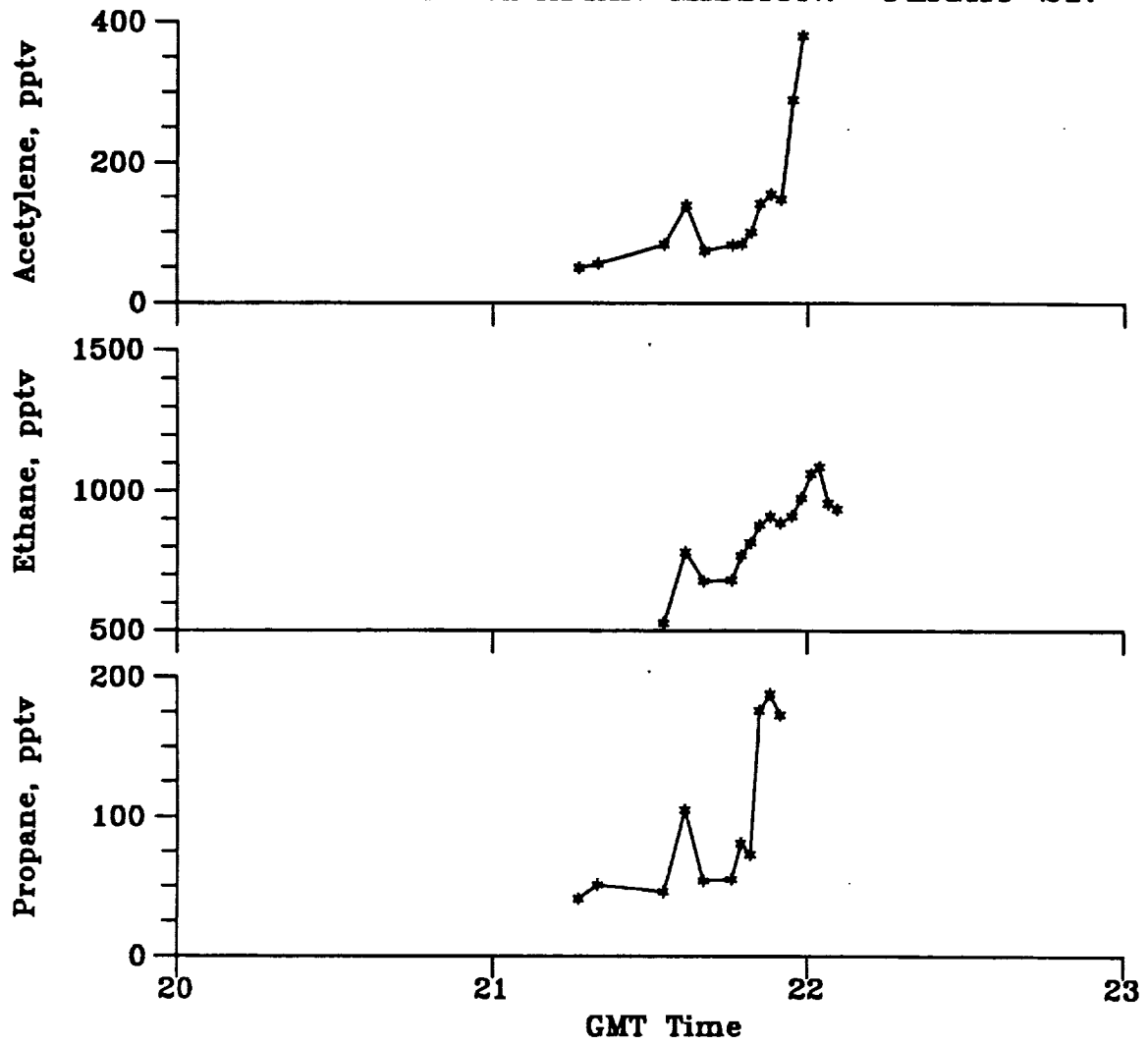


Figure B21.4

ABLE-3B CANADIAN MISSION: FLIGHT 21 PROFILE AT 2145 GMT

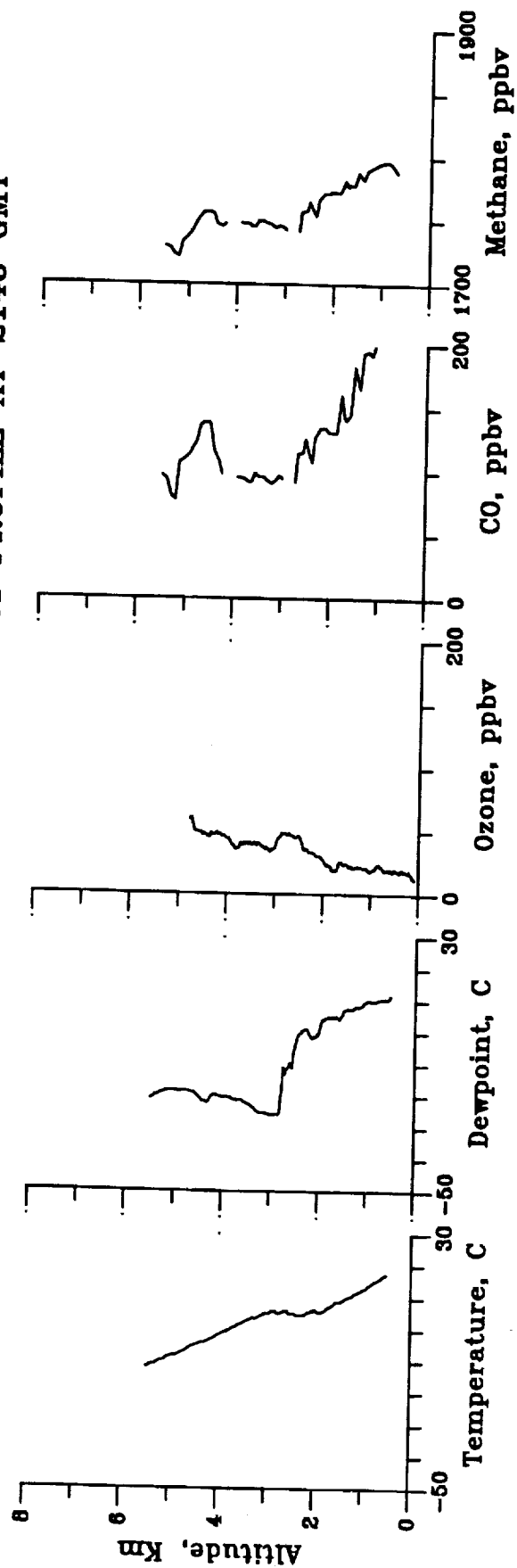


Figure B21.5

ABLE-3B CANADIAN MISSION: FLIGHT 22.

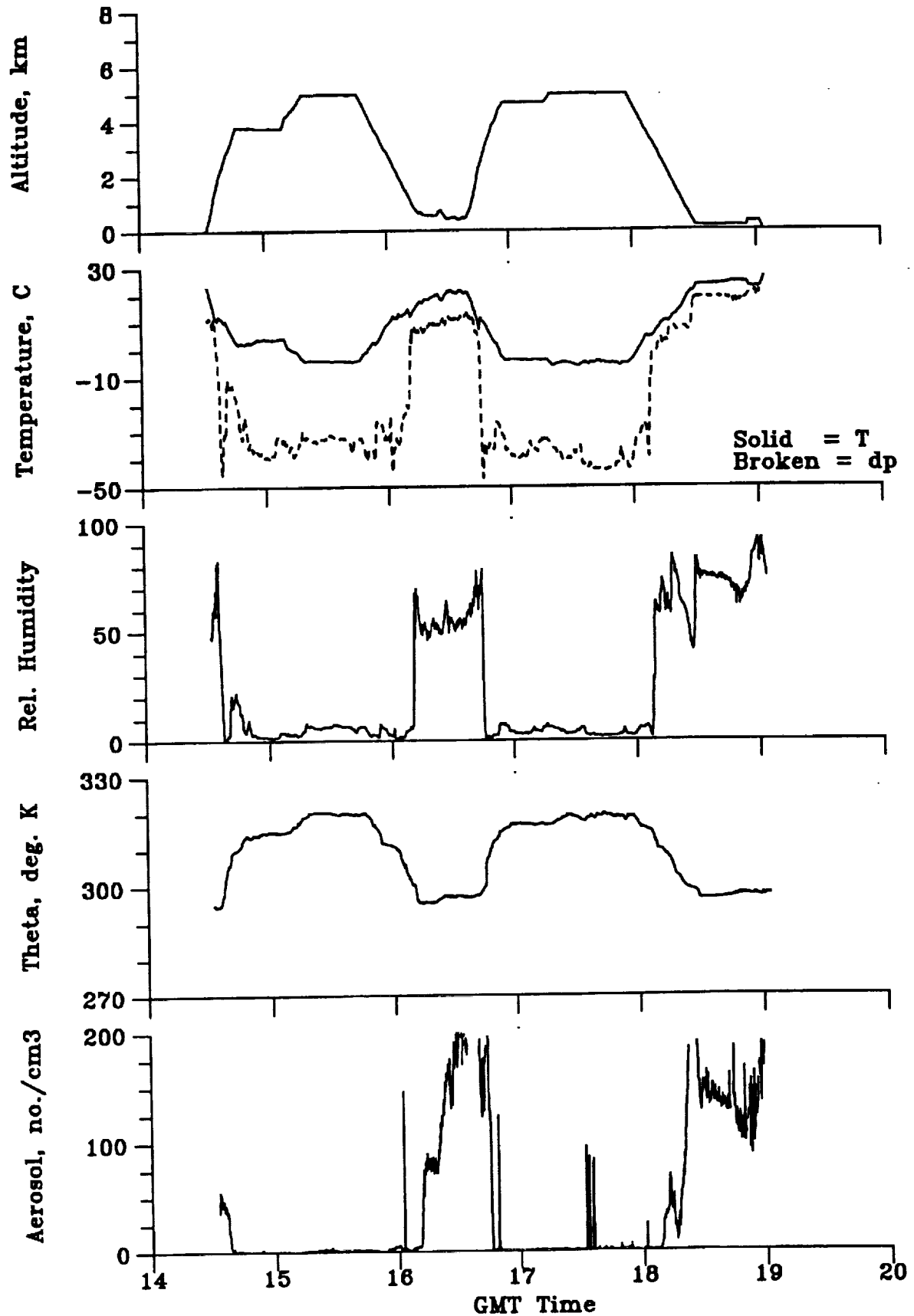


Figure B22.1

# ABLE-3B CANADIAN MISSION: FLIGHT 22.

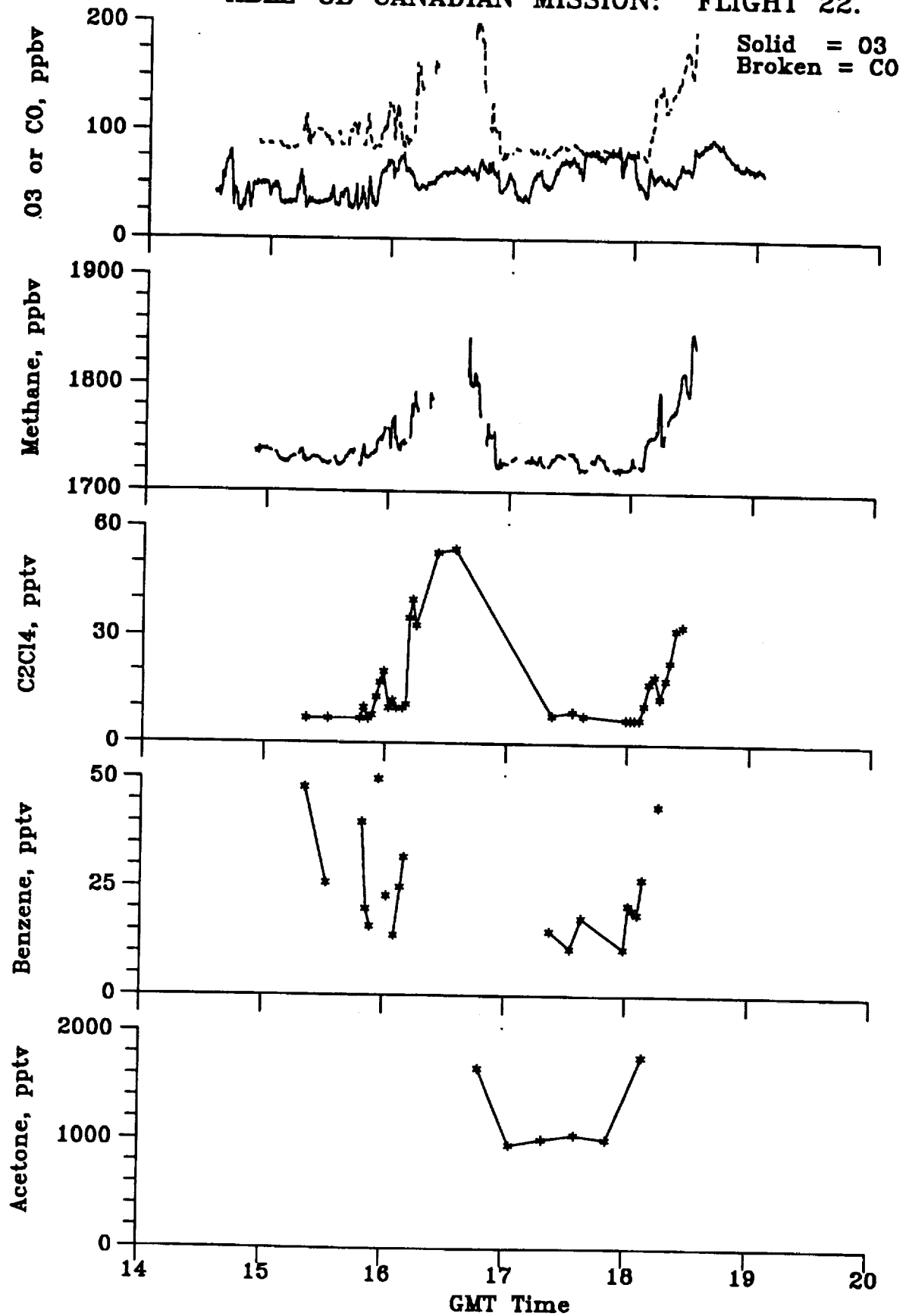


Figure B22.2

# ABLE-3B CANADIAN MISSION: FLIGHT 22.

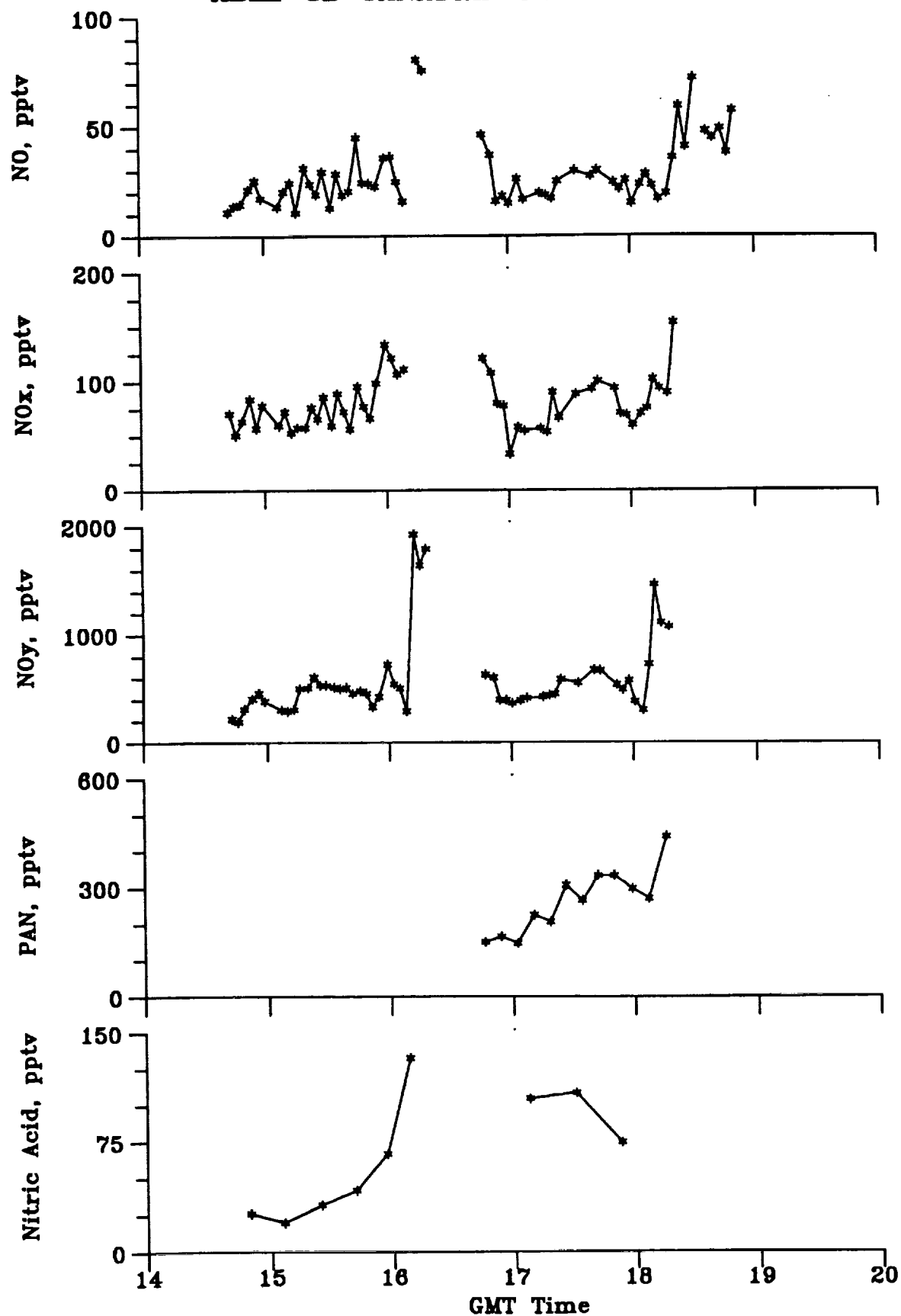


Figure B22.3

# ABLE-3B CANADIAN MISSION: FLIGHT 22.

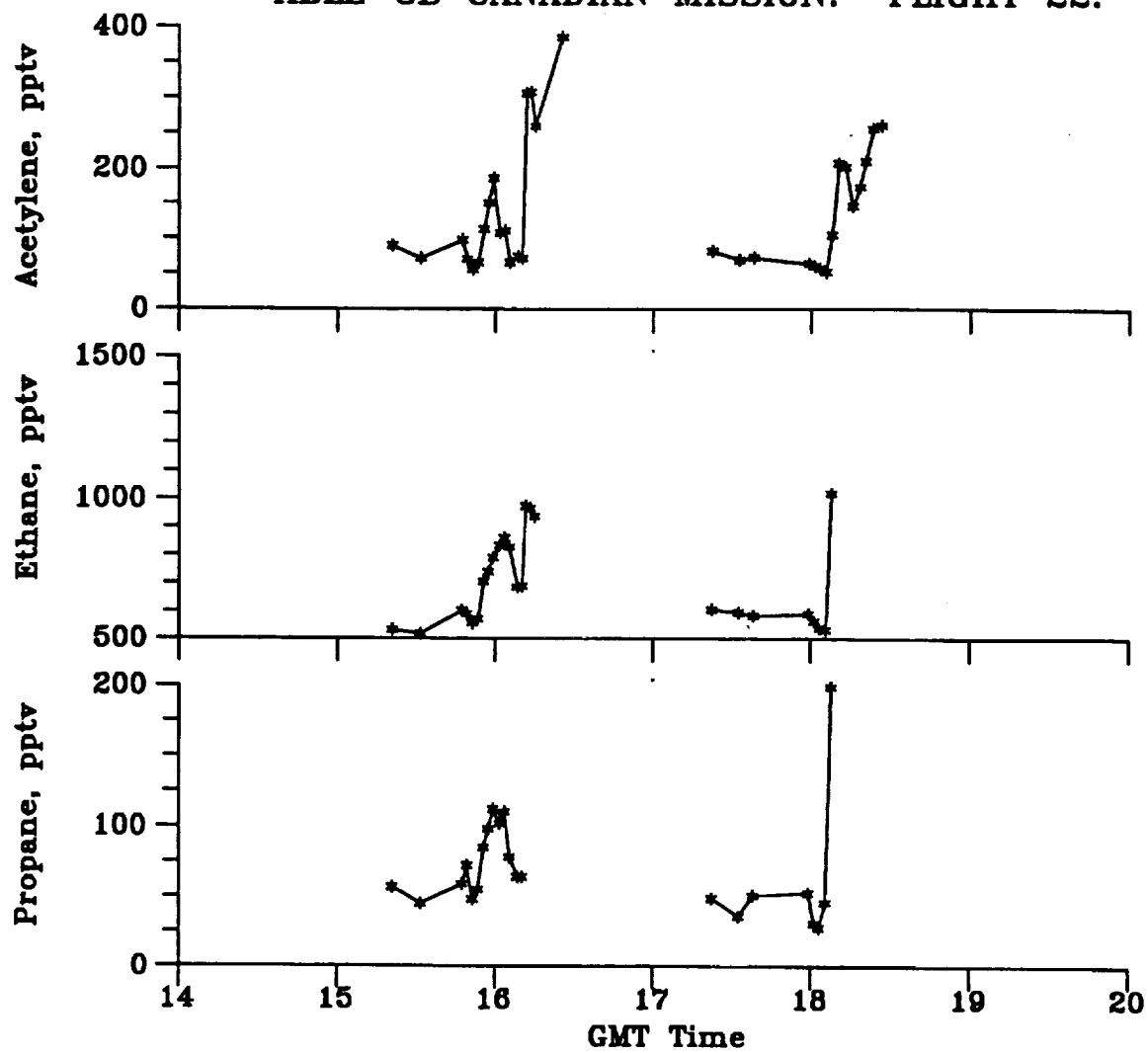
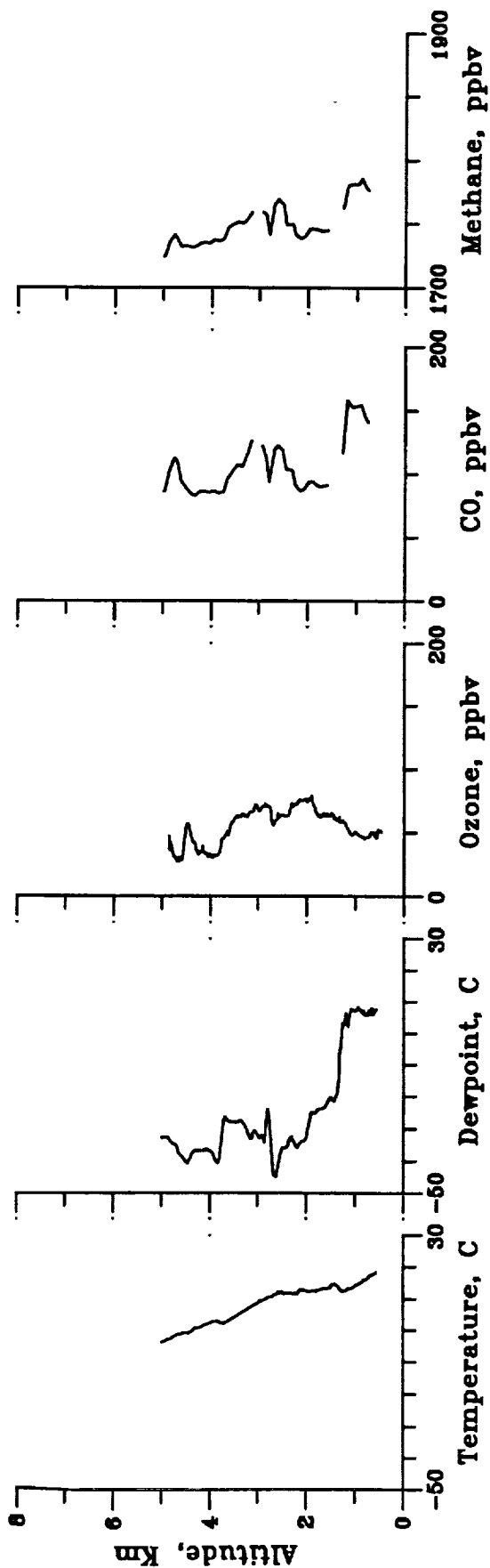


Figure B22.4

ABLE-3B CANADIAN MISSION: FLIGHT 22 PROFILE AT 1600 GMT



ABLE-3B CANADIAN MISSION: FLIGHT 22 PROFILE AT 1815 GMT

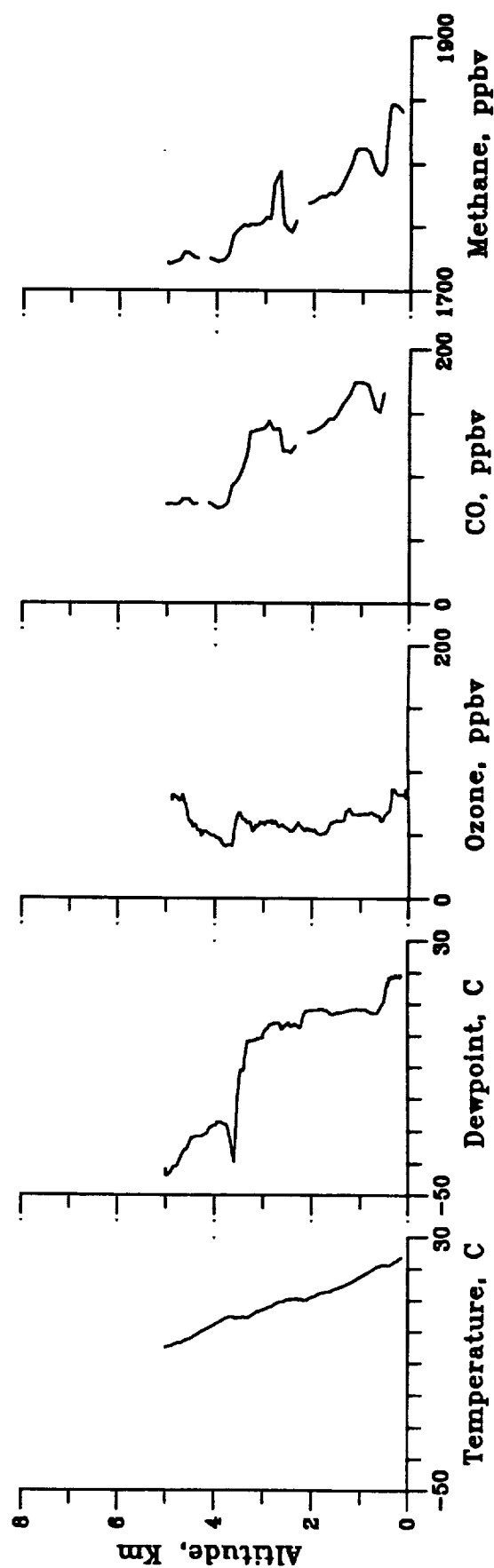


Figure B22.5





REPORT DOCUMENTATION PAGE			Form Approved OMB No. 0704-0188	
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6. AUTHOR(S) Gerald L. Gregory and A. Donald Scott, Jr.				
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13. ABSTRACT (Maximum 200 words)  The report provides a compendium of NASA aircraft data that are available from NASA's Global Tropospheric Experiment's (GTE) Arctic Boundary Layer Experiments (ABLE) conducted in July and August of 1988 (ABLE-3A) and 1990 (ABLE-3B). ABLE-3A flight experiments were based at Barrow and Bethel, Alaska, and included survey/transit flights to Thule, Greenland. ABLE-3B flight experiments were based at North Bay (Ontario) and Goose Bay, Canada, and included flights northward to Frobisher Bay, Canada. The primary purposes of the experiments were (1) the measurement of the flux of various trace gases from high-arctic ecosystems, (2) the elucidation of factors important to the production and destruction of ozone, and (3) the documentation of source and chemical signature of air common to and transported into the regions. The report provides a representation, in the form of selected data plots, of aircraft data that are available in archived format via NASA Langley's Distributed Active Archive Center. The archived data bases include data for other species measured on the aircraft as well as numerous supporting data, including meteorological observations/products, results from surface studies, satellite observations, and sondes releases.				
14. SUBJECT TERMS  Troposphere chemical composition Arctic troposphere Aircraft tropospheric measurements			15. NUMBER OF PAGES 271	
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